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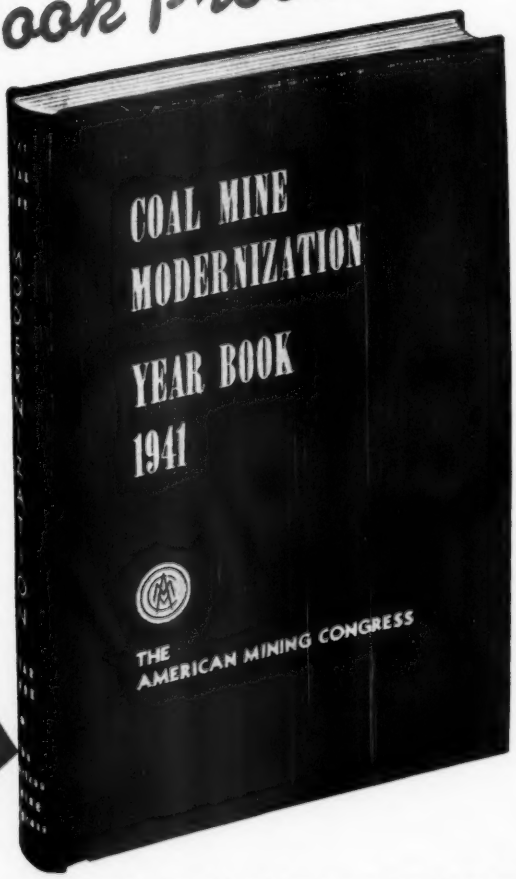

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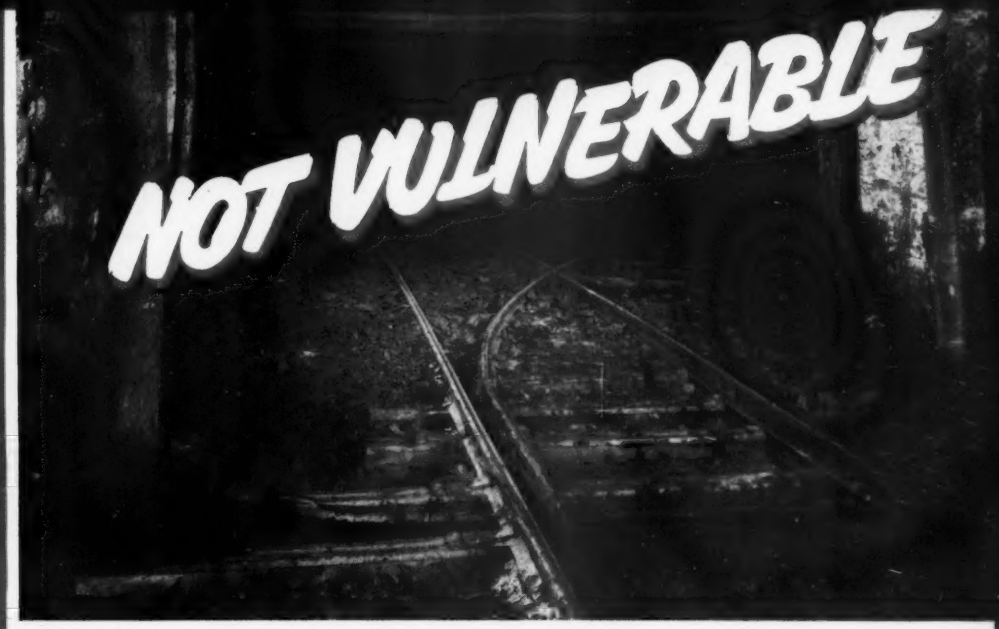

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MINING CONGRESS JOURNAL

Vol. 27 — MAY, 1941 — No. 5

The 18th Annual Coal Convention and Exposition is over, and many expressions of satisfaction are being received from both operators and manufacturers. The complete story of the meeting is told in this issue.

The metal mining fraternity will have a similar opportunity this fall to meet for a discussion of their problems, and to see and appraise the latest and best in mining equipment and supplies. Plans are already well under way for the 8th Annual Metal Mining Convention and Exposition at San Francisco on September 29-October 2.

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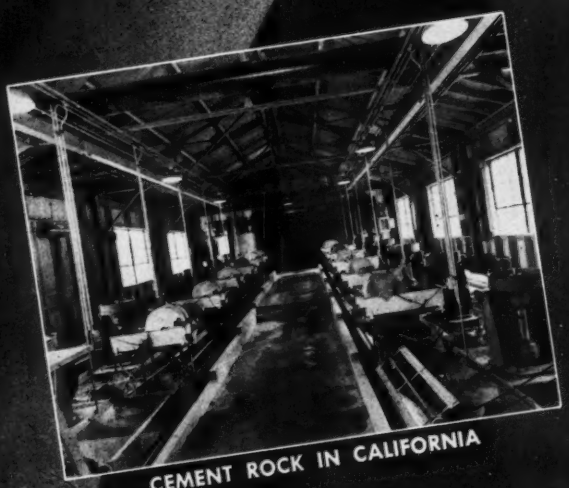

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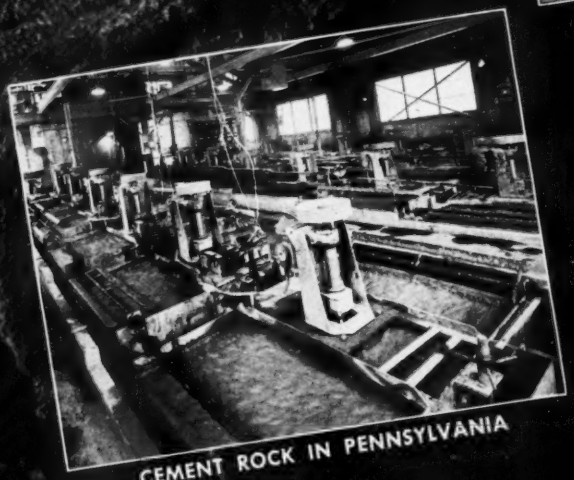

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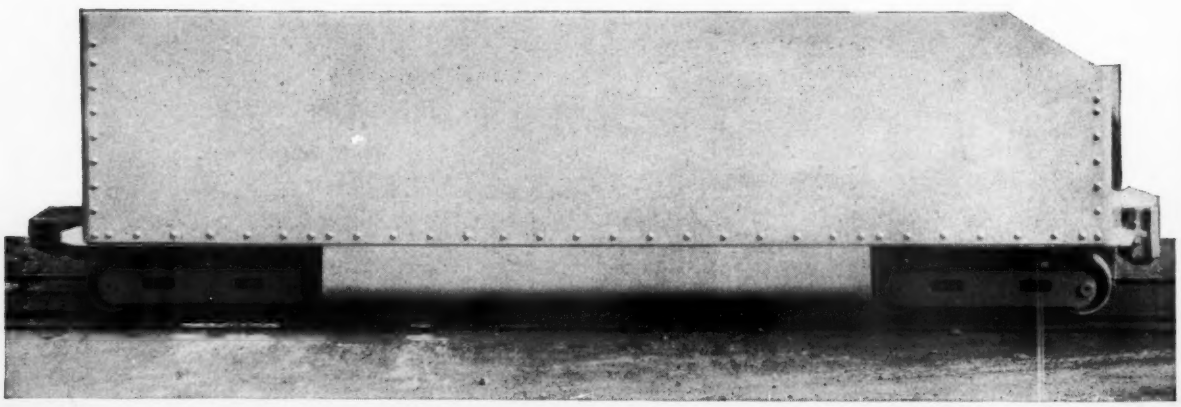

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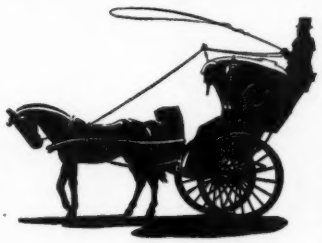

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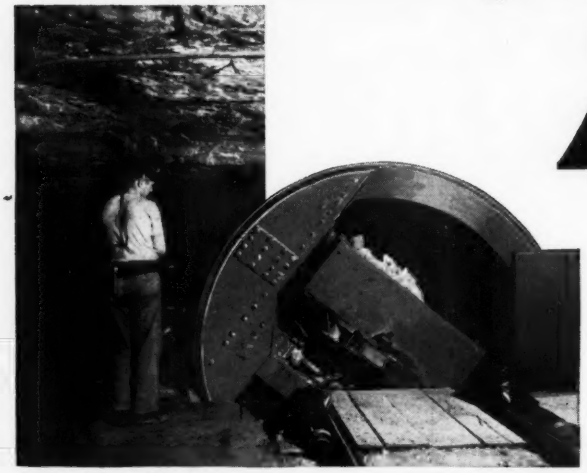
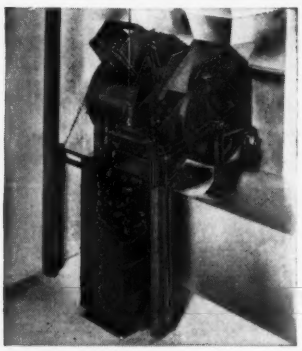
DETERMINED SELECTION OF LINK-BELT EQUIPMENT

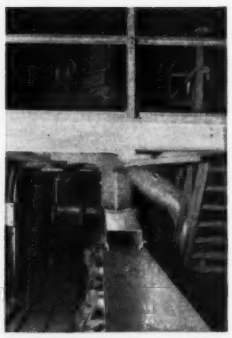
by Union Potash & Chemical Co.



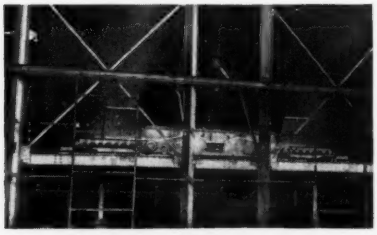
ROTARY DUMPER Link-Belt Electrically-operated Rotary Mine Car Dumper on 900-ft. level dumping one of the 6-ton ore cars into the primary crushing bin and skip loading pocket at No. 1 shaft of Union Potash and Chemical Co.'s mine, Carlsbad, N. M. This dumper is started and automatically slowed down and stopped by push button control.



SKIP LOADERS Two 9½-ton capacity Link-Belt automatic skip loaders of the type illustrated above, assure large hoisting capacities at this mine. These automatic loaders not only cut hoisting costs, but also save through the elimination of the work of cleaning up spillage which usually occurs with the manual loading method.



SHUTTLE CONVEYOR Link-Belt Shuttle Belt Conveyor which receives ore from main storage belt conveyor and discharges to bins in the storage building. This view is taken looking toward one of the discharge ends, directly under the spout to which the main storage belt conveyor delivers material. Head end of main storage belt conveyor is shown at top of the illustration.



PAN FEEDERS Two Link-Belt Pan Feeders handling ore from storage bins to a belt conveyor which delivers to crusher plant.

• The Union Potash & Chemical Co. mine at Carlsbad, N. M. stands today as an excellent example of what is being accomplished in the non-metallic mining field in attaining complete electrification and mechanization.

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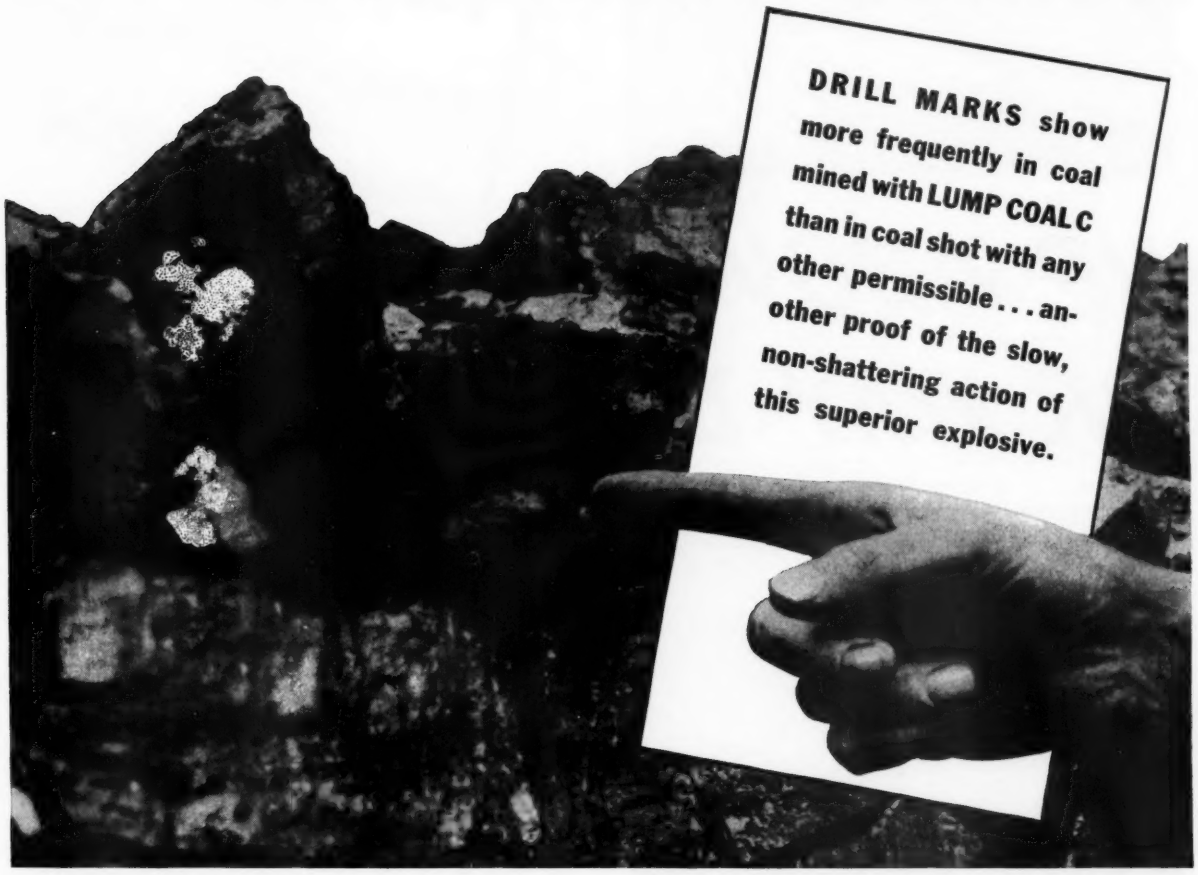
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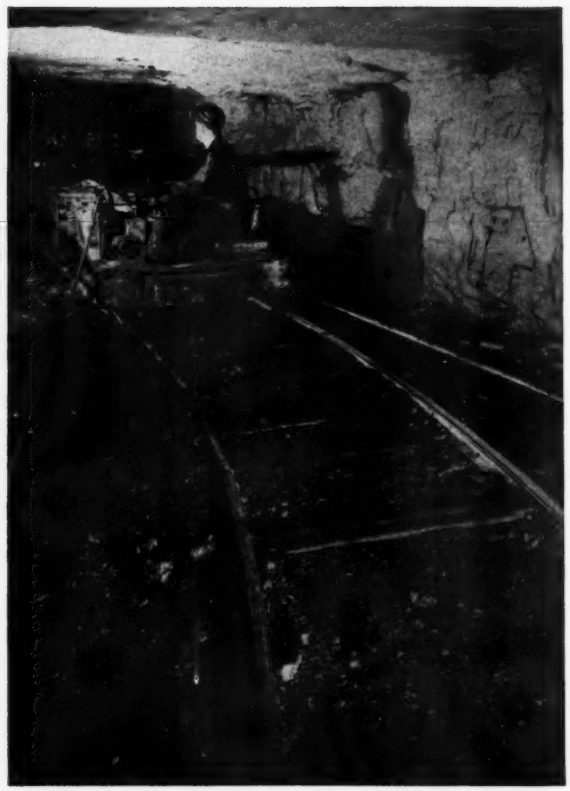

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A JOURNAL FOR THE ENTIRE MINING INDUSTRY—PUBLISHED BY THE AMERICAN MINING CONGRESS

MINING CONGRESS JOURNAL

RUSSELL C. FLEMING
Editor

Vol. 27 MAY, 1941 No. 5

PRIORITIES AND MINERAL PRODUCTION

MACHINE tools are said to be the only non-living objects that can reproduce themselves. But the same can be said of minerals and coal. Metals, alloys and fuels are absolutely necessary, in the final form of mining machinery, in order to obtain production of these materials in the raw state. Now, when the production of these sinews for defense is so vitally needed, a stoppage or diversion by governmental priorities, of the flow of certain metals and alloys from the production of mining machinery to other uses, can result in serious interference with primary production.

The American Mining Congress, recognizing this danger, is taking action, one phase of which is expressed in a letter from Julian D. Conover, Secretary, to the Office of Production Management, in which this problem is succinctly expounded. Quoting in part:

"You are of course familiar with the basic nature of the mining industry and the essential part which its products play in the national defense program and in our whole industrial structure. The coal and metals produced by our mines are indispensable in supplying the heat and power and the basic raw materials both for armaments and for the necessities of daily life. With increasingly heavy demands upon our mines, it is urgently necessary that they be in position to maintain steady operation.

"Without going into detail, it may be pointed out that iron ore production this year must be at an all-time high to meet current requirements for steel production. As to zinc, copper and lead, domestic mine production, though at capacity rates under existing prices, is inadequate to meet demands, and it is being found necessary to import substantial quantities of foreign metals. Of the strategic and critical minerals—tungsten, manganese, mercury, antimony, chromium, aluminum, vanadium, etc.—although a general policy of encouraging domestic production is being pursued, supplies in most cases are far from adequate; certainly no impediment to production through priority restrictions on materials for mining equipment should be placed in the way of their development.

"Coal production is basic to our whole industrial machine, both as a raw material for the steel and chemical industries and as the major source of power for production and transportation; recent figures compiled by the Bituminous Coal Division of the Department of the Interior show that 79 percent of the total bituminous coal consumption in 1940 was for industrial uses. With increased defense production, far heavier consumption of coal may be anticipated in the coming months, and demands for capacity production from the mines are in prospect.

"Statements have been made that our coal mines are prepared to meet all demands upon them. This is true only on the assumption that they are enabled to operate continuously, with adequate personnel and transportation facilities, and especially with a continued supply of mining machinery, and of replacement parts to maintain existing equipment in first-class operating condition.

"In both coal and metal mines, the past 15 years have seen a progressive process of mechanization. The mines of today as a whole are directly dependent on modern mining machinery in every phase of their operations—cutting (of coal), drilling, blasting, loading, haulage and surface preparation or concentration. To suggest, for example, that a shortage of coal loading machinery might be met through a resumption of hand loading is to ignore the basic conditions of operation. Loading is only one phase of mining, and machines would still be required for cutting, drilling, haulage, pumping, ventilation, hoisting, cleaning, screening, etc. Not only is the necessary labor for hand loading unavailable, but with the far smaller production of coal possible from a given area, the opening of many additional working places would be required, involving time and a vast amount of additional equipment.

"Mining machinery must be of rugged construction to stand severe and long continued service. It must be able to operate continuously with a minimum of time lost through breakdowns. In the manufacture of such machinery, consequently, liberal use is made of special alloy steels and other metals which are particularly adapted to withstand the stresses to which they are subjected. A substitution of inferior materials would mean costly breakdowns, decreased production and the loss of many man-hours that should be devoted to productive effort. In many cases, the substitution of such materials, involving greater size or weight, would not be possible in machines of existing design. Most mining machinery, such as pneumatic drills, coal cutters, locomotives, loading machines and other portable equipment must be of extremely compact design and minimum weight for safe handling in confined underground spaces, hence use must be made of the space- and weight-saving qualities of special materials.

"If our metal and coal mines are to be kept in continuous operation, it is essential that replacement parts and new machinery as needed be available to them without delay. The failure of a key machine, such as a ventilating fan or a mine pump, may shut down an entire mine for an indefinite period unless the necessary replacement parts can be obtained and installed promptly. Such a shut-down may contribute materially to a shortage of vitally needed defense raw materials.

"Generally, mining companies do not carry any extensive inventory of replacement parts, but depend upon the manufacturers to carry stocks for immediate shipment. Manufacturers in order to maintain reasonably adequate stocks must schedule their shop pro-

(*Continued on page 55*)

Canisteo Mine: Crushing plant in pit; belt conveyor gallery and transfer stations, leading to concentrator at ground level

Improvements at the CANISTEO MINE

By W. A. STERLING
District Superintendent
Cleveland-Cliffs Iron Company

\+ + +

The Canisteo iron-ore mine at Coleraine, Minn., has been modernized by many changes; truck haulage has replaced steam haulage in the pit, the concentrating plant has been moved to the pit edge, a belt conveying system installed from the coarse crushing plant in the pit bottom to the concentrating plant. These with other major improvements have resulted in a most compact and efficient operation.

\+ + +

THE Canisteo Mine is an irregular shaped open pit covering approximately 220 acres. It was opened by the Oliver Iron Mining Company in 1906 and operated by them through the year 1925. Approximately 18,000,000 tons of merchantable ore and concentrates were mined and shipped from the property, exhausting all of the Direct Shipping Ore and leaving a grade which would require further concentration. In 1924 the mine was returned to the lessor, the Canisteo Mining Company, and held by that Company until 1929, when it was leased to The Mesaba-Cliffs Mining Company. It was operated by the latter Company through the year 1938 and approximately 4,000,000 tons of ore were mined and shipped. The lease was terminated on January 1, 1939, leaving in the property sufficient wash ore to produce approximately 6,000,000 tons of concentrates.

Mining Costs Had Been High

High taxes, high labor rates, and a gradually increasing mining cost made the property expensive to operate under the existing mining methods. The high mining costs were due to the following conditions:

1. The stripping was expensive, for the waste dumps were so situated that a five-mile haul was entailed.

2. The track costs were excessive in that there were approximately 15 miles of track to maintain.

3. The ore haulage costs were high; the haul from the pit bottom was about six miles, with a maximum grade of 2½ per cent, and as the pit deepened this haul increased through numerous switch-backs.

4. The ore body was irregular and proper grading required constant switching of shovels and loading tracks, which meant opening and maintaining several loadng places, and the track extensions often required extensive rock work.

5. The concentrating costs were high for, in addition to a long haul for the crude ore, the water supply for washing had to be augmented by pumping from the pit. This meant a lift of about 350 feet through approximately 6,000 feet of pipe line.

6. The general open pit expenses, including pumping and general pit maintenance, were excessive unless a large tonnage of ore was mined.

7. The winter repair costs on the locomotives and cars were very high, for an adequate supply of crude ore required the use of six locomotives and 24 dump cars. This equipment was used in both the mining and stripping, and the necessary repairs were quite extensive.

Canisteo Company Plans for More Efficient Operation

After the Mesaba-Cliffs terminated the lease, the Canisteo Mining Company decided itself to operate the property. A study was made of the existing conditions with the view of developing a more economical method of mining. Electric haulage, using pilot cars and operating on steeper grades than steam, was considered. A combination of truck and steam equipment, in which the material would be hauled by truck to a pit pocket where it would be transferred to dump cars and delivered to the concentrator, was also investigated. The Canisteo Mine problems seemed best solved by a combination of truck haul and conveyor belt delivery from the pit bottom to

the top of a concentrator located at the edge of the pit, for the following reasons:

1. Lands were available for waste dump sites adjacent to the various areas requiring surface stripping, which permitted hauling of waste material by trucks a very short distance.

2. The concentrating plant could be moved to the edge of the pit and a conveying system installed to the pit bottom without tieing up any mineable ore.

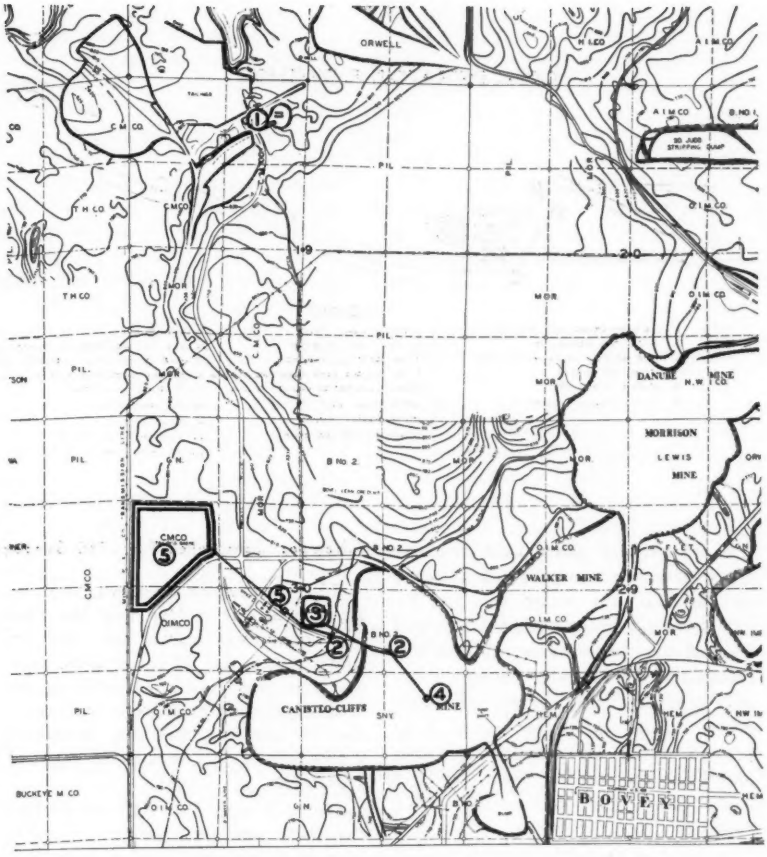
3. An excellent tailings basin site was available within a half-mile of the proposed new washing plant location.

4. There were sufficient worked-out areas in the pit for disposal of all pit rock and any rock which would be discarded in the crushing plant in the pit. These areas could also be used as dumps for waste rock and paint-rock stripping in the pit bottom.

5. The large inflow of pit water would furnish an ample supply for all concentrating purposes.

6. A truck operation would not only make available isolated bodies of ore and the deposits formerly tied up in track benches, but it would greatly simplify grading problems.

A plan was adopted early in the spring of 1939 and an arrangement was made with The Cleveland-Cliffs Iron Company to act as "Operating Agent." Since there was not sufficient time to affect a complete change-over, it was decided to operate during the 1939 ore season with a combination of truck haulage and delivery by steam equipment. The ore was hauled from the power shovels to a transfer pocket in the pit, loaded into dump cars and hauled by steam to the washing plant. Three, four-car trains and six trucks were required for the gathering and delivery of the ore. Six Euclid 15-ton rear-end-dump trucks, a D-8 "Caterpillar" tractor, and a Road Patrol were purchased, the latter two machines being used in building and maintaining roads, using material at hand. The operation worked out very well and demonstrated the economy of truck haulage in this type of mining.



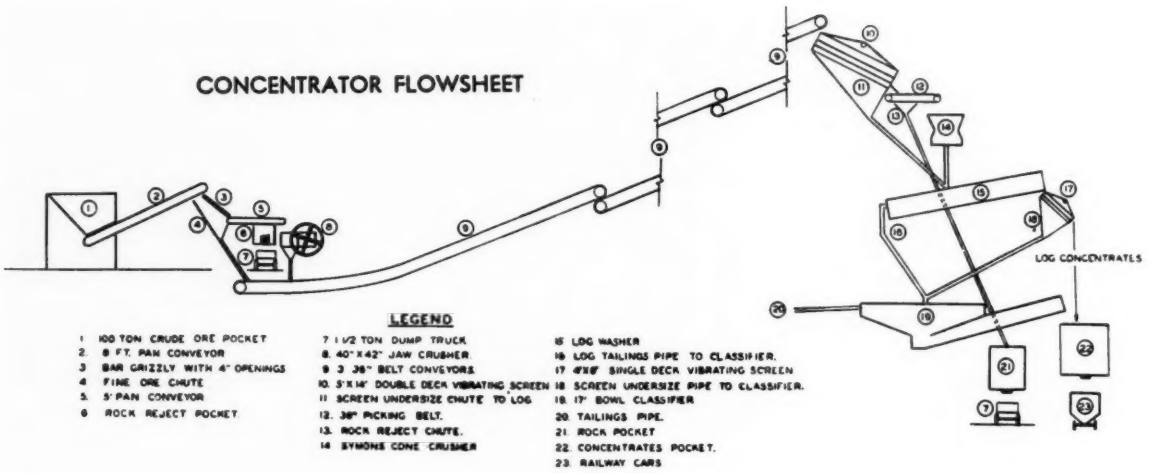
Plant layout, with revisions and additions recently completed

1.—Old location of washing plant and railroad from pit.
2.—New location of washing plant.
3.—Pond for water storage.
4.—Pump in pit delivering 1,500 G.P.M. through 10-in. pipe line to storage pond.
5.—Tailings pump and 12-in. pipe line to tailings pond.

Following the 1939 ore season, work was started to complete the change-over to the conveyor system. The railway tracks were removed from the property and the concentrator was moved to its new location near the edge of the pit.

A new tailings pond was located and encircled with a dike 15 feet high and 18 feet wide at the top, using surface material which was hauled by truck from adjacent stripping operations. The equipment installed to handle the tailings consisted of 800 feet of 16-inch pipe, through which the tailings were flumed to a 12-inch Hydro-Seal pump. From here they were forced against a 20-foot static head, 1,700 feet through a 12-inch pipe line into the tailings basin.

15-ton truck dumping into receiving bin at crushing plant


CONCENTRATOR FLOWSHEET
LOG CONCENTRATES
LEGEND
1 100 TON CRUDE ORE POCKET
2 8 FT. PAN CONVEYOR
3 BAR GRIZZLY WITH 4" OPENINGS
4 FINE ORE CHUTE
5 5' PAN CONVEYOR
6 ROCK REJECT POCKET
7 1 1/2 TON DUMP TRUCK
8 40" X 42" JAW CRUSHER
9 3 36" BELT CONVEYORS
10 5' X 14' DOUBLE DECK VIBRATING SCREEN
11 SCREEN UNDERSIZE CHUTE TO LOG
12 36" PICKING BELT.
13 ROCK REJECT CHUTE.
14 SYMONS CONE CRUSHER
15 LOG WASHER
16 LOG TAILINGS PIPE TO CLASSIFIER.
17 4'X8' SINGLE DECK VIBRATING SCREEN
18 SCREEN UNDERSIZE PIPE TO CLASSIFIER.
19 17' BOWL CLASSIFIER
20 TAILINGS PIPE.
21 ROCK POCKET
22 CONCENTRATES POCKET.
23 RAILWAY CARS

A 10,000,000-gallon capacity clean water reservoir was provided adjacent to the mill and water was fed by gravity to pumps located on the ground floor of the concentrator. Water was pumped to the reservoir through a 16-inch pipe line from the pit by means of a 1,500 gallon-per-minte high pressure pump, and through a return line from the settling basin, using a 2,000 gallon - per - minute low - head pump.

A 100-ton capacity concrete pocket and the crushing plant were erected in the pit. They were located on the pit floor in a rocky worked-out area and connected with the concentrator building by a 1,000-foot long conveying system. The latter is a 36-inch belt conveyor built on an 18° slope and covered with a steel gallery. It was constructed in three sections with two transfer houses.

The main haulage roads are 50 feet wide—one leading to the pit pocket from the south side and one from the east side of the pit. They were built up with material at hand, using taconite and paint-rock for the main fills, and dressed with a rubbly material. The high fills were built up in low lifts, compacting the material under truck traffic, and thus avoiding any appreciable settlement later.

In addition to the six trucks, the tractor and the grader, which had been formerly purchased, two 85-B Bucyrus-Erie shovels with 3¼-yard welded dippers, two Bucyrus-Erie 27-T combination blast hole and structural drills, and a road sprinkler, were purchased. The latter is used to lay the dust and to help maintain a smooth, hard hauling surface.

Changes Completed for 1940 Season

The preparatory work was not finished until late in May, and the 1940 ore season was started on May 29, using four to five 15-ton trucks, hauling from two shovels. A 600-ton per hour supply of crude ore is trucked to the pit pocket, the haul averaging 2,400 feet, with a maximum grade of 8 per cent.

Dumped into the 100-ton pocket, the crude ore is carried by an eight-foot pan conveyor to a four-inch grizzly. The undersize from the latter is fed through a chute direct to the 36-inch belt conveyor. The oversize falls on to a five-foot pan conveyor, leading to a 40-inch by 42-inch primary jaw crusher. The large rock is scalped from the five-foot pan and dropped into the rock chutes from which it is hauled by truck to adjacent waste dumps.

The oversize ore material is crushed to four-inch size in the primary crusher and fed through a chute to the 36-inch belt conveyor, falling upon a cushion of undersize material. By means of the conveyor it is delivered 1,000 feet on an 18° slope to the top of the washing plant, passing through two transfer houses. At the top of the mill it is dumped on to a five-foot by 14-foot double deck vibrating screen, the undersize going directly to log washers. The oversize is carried on 36-inch picking belts, where additional rock is hand-picked, to secondary cone crushers which reduce the material to a five-eighths-inch size and then feed it into the log washers.

The log product is passed over four-foot by six-foot vibrating screens, where it is deslimed and fed directly into the concentrate bin. The log tailings and the tailings from the desliming screens are carried to 17-foot Dorr bowl classifiers for further concentration. The classifier product is taken to the concentrate bin by means of 24-inch cross conveyors, where it

Side of crusher building, truck for rock disposal being loaded

is mixed with the log product and fed directly into ore cars for shipment. The classifier tailings are carried through the tailings disposal system to the settling basin.

Nearly 500,000 Tons of Concentrates Produced in 1940

Operation of the mine for 1940 was completed early in October, having produced nearly 500,000 tons of concentrates.

The new method of mining worked out very well in a smooth, continuous operation, and it was found that our anticipations were actually bettered. In this particular operation the following advantages of truck gathering and conveyor belt delivery over steam locomotives gathering and delivery, were demonstrated:

1. With a short haul to adjacent dumps and with a lower initial expense, surface stripping costs were reduced. In the case of taconite and rock stripping in the pit bottom a further reduction was realized through the elimination of the long expensive haul to surface stripping dumps.

2. In the gathering and delivery of crude ore, the cost of truck and conveyor operation and maintenance, including all road costs, was less than half the cost of operating locomotives and cars and providing and maintaining hauling and loading tracks.

3. The grading problem was very much simplified through a flexible operation. Shovels were moved on established roads, and the cost of shifting a truck operation was but a fraction of that required in the use of locomotives, cars and loading tracks.

4. Costly rock work was reduced through the elimination of rock cuts for track grades and through lower pit rock costs. The latter, when encountered in mining, could either be cast aside in the rocky area, or hauled by truck to adjacent worked-out areas in the pit, saving the long costly haul to the surface stripping dumps.

5. An increased tonnage of ore was made available through the elimination of track benches. Isolated deposits and deep ore bodies could likewise be mined readily.

6. The labor cost per ton was reduced through the elimination of large track gangs and shop crews. With fewer men and with practically every man a producer, the operation could be conducted efficiently on a small, as well as large program.

7. The maintenance cost on the motorized equipment was very much less than that required for locomotives and cars.

In short, the new method of mining proved to be simple, flexible, and economical and especially adapted to a pit of this type.

Minimum Coal Prices to be Reviewed

Secretary of the Interior Harold L. Ickes announced that the Bituminous Coal Division of the Department of the Interior will open a hearing on May 21 to determine changes in the costs of producing coal since the cost-base for minimum prices was established.

The hearing, he said, will provide the basis for making necessary changes in the minimum prices to keep them in line with the coal industry's operations costs. It will be held in Washington, D. C., before a Division trial examiner.

Preliminary figures, based upon 1940 mining operations recently released by the Division, indicate a substantial reduction in costs in each of the minimum price areas, and an average national reduction of approximately 18 cents per ton.

However, Secretary Ickes pointed out, the Division also will receive evidence concerning current changes in costs, including the effect of increases in wages paid by the industry as a result of the negotiations between producers and miners which opened this spring.

The Coal Act requires minimum prices to be revised appropriately whenever it has been determined that the "weighted average cost" of producing coal in any minimum price area has changed in excess of two cents per ton. The minimum prices were established to maintain a "cost floor" under the sale of coal at the mine and to end the destructive price-cutting which has kept the coal industry in a demoralized condition for many years.

The Division has announced that a pre-hearing conference will be held at its offices in Washington on May 19 at 10 a. m., at which time matters of procedure will be discussed with all interested persons with a view toward expediting the hearing which opens May 21.

The initial stages of the hearing will be concerned with the determination of cost changes, but the full scope of the hearing will cover both the cost phase and any appropriate adjustment of minimum prices based upon cost changes.

The order setting the hearing provides that all interested parties will be given a full opportunity to be heard, to examine and cross-examine witnesses, to present evidence relating to the correctness or incorrectness of the Division's preliminary cost figures and to present their own evidence relating to the extent of changes in costs in excess of 2 cents per ton. Interested persons also will be afforded full opportunity to participate in a similar manner in the price-adjustment phase of the hearing.

The order states that all parties desiring to participate in the hearing must file a notice to that effect with the Division on or before May 19, 1941.

The Division recently released cost computations covering mining operations for 1938, 1939 and 1940. It announced in the hearing order that the individual sworn cost reports filed by producers, from which these computations were made, have been made available for inspection by interested persons at the Division's offices in Washington. This will afford all interested persons an opportunity to check the accuracy of the Division's compilations, and to enable them to prepare their evidence and participate in the hearing.

The present minimum prices were based on 1936-1937 "adjusted" costs, and the costs of operations for 1940 indicate a decrease of 18 cents per ton under the cost-base for the present price schedules.

Guffey Act Extension Does Not Affect Code Membership

After the Guffey Act was extended for two years by Congress in April, a statement was issued by Director Harold Gray of the Bituminous Coal Division, clarifying the status of code members under the Act as extended, as follows:

"Code members are advised that their membership in the Bituminous Coal Code as promulgated pursuant to the Bituminous Coal Act of 1937, does not expire or terminate on April 26, 1941. Section 19 of the Bituminous Coal Act of 1937, as originally passed by Congress, provided that the Act was to expire on April 26, 1941. Recently Congress has amended Section 19 so as to provide that the Act shall continue to be in effect until April 26, 1943.

"However, any producer who desires to present for consideration of the director a request for withdrawal from the code predicated upon the April 26, 1941, expiration date provided in the Bituminous Coal Act of 1937, may do so by making formal application to that effect not later than fifteen (15) days from the date hereof. Non-code members are subject to the tax imposed by Section 3 (b) of the Act, of nineteen and one-half (19½%) percent of the sale price or the market value of all the coal sold or otherwise disposed of."

OPEN PIT COAL MINE HAULAGE*

By ERIC E. LAURELL
Superintendent
Buckheart Mine
United Eelectric Coal Companies

Heavy duty truck haulage at open pit mines, with its continuous traffic of large units, demands good roadways for satisfactory service. This article describes in detail the construction of two types of roadway for this service, after tests had indicated the proper types to suit each local condition.

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IN THE open-pit coal mines in Illinois coal is hauled from the loading shovels in the pits by rail and by trucks. In this paper a description is given of two methods used to build roadways for truck haulage.

Road Building at the Buckheart Mine

During the past period of November, December, and January a daily average of 4,328 tons of raw coal was hauled by trucks from the pit to the preparation plant at the Buckheart mine of the United Electric Coal Companies, Fulton County, Ill. The average length of haul in January, 1941, was 1.3 miles or 2.6 miles per round trip, and the average total miles run per day or shift of 7 hours per truck was 67.5. The types of trucks used were the Walters 4-wheel drive and the Auto Car rear-wheel drive, each truck pulling an Austin Western 33-cu.-yd. bottom-dump semitrailer. The average payload per trailer was 23.8 tons. This haul was made over a 2-lane roadway, .7 mile of which was paved with gravel and .6 mile of berm or existing coal surface.

Due to the proximity of workable gravel banks, lake gravel here is considered the most economical and suitable material for road ballast and surfacing. To build a main coal haulageway with this type of material the following procedure is practiced:

After the location and path of the haulageway is decided upon, first comes the primary grading, in order to secure a good base; this is of the utmost importance. The best season of the year for this type of work is from May to September. For cut and fill work a 1½-cu.-yd. dragline, a tractor and scoop, and a bulldozer are used. For grading, an auto patrol, and for packing and tamping a 9-ton concrete and steel roll is used. The base of the roadway is formed from the native earth, which consists mostly of sandy yellow loam and clay. This is worked with the road patrol until a proper mixture for packing is made. The surface of the base is crowned as much as is possible with the blade of the road patrol, and good deep ditches with sufficient grade to drain quickly the roadway are made. This work of grading is done in dry weather and the roll is kept continuously working with the road patrol. Sometimes when possible the empty trip of the trucks returning to the pit is routed over this section to travel-pack the base.

The next step is to lay the ballast on top of the base. When the coal haulage trucks are available, gob which has caught on fire from a surface dump is loaded with a dragline into the semitrailers and spewed in windrows over the base of the roadway to be worked and spread with the auto patrol.

After optimum moisture content is reached, the mass is bladed to proper depth over the entire area, and compacted as shown here by sheepsfoot roller and motor patrol for shaping.

This is then rolled so that the first layer of ballast is approximately 3 in. deep. Then in the same manner three more layers of burning gob are applied. Then a thin layer of screened gravel, minus 2 in. to plus ¾ in., is spread over the gob with dump trucks and worked into the top layer of gob with the road patrol and roller. If weather conditions are dry the road is sprinkled with water and traffic is routed over this section to travel-pack the ballast. The surface is made smooth by rolling and then the work of applying earthbound gravel, which is the run-of-the-gravel-pit unwashed 1¼ in. by 0 in. gravel with a slight mixture of sand and clay, in approximately 1-in. layers, is started. Traffic is now routed continuously over the roadway until four of these layers are applied. After the fourth layer of earthbound gravel is applied the roadway is used for traffic for approximately a month. During this time, as holes and soft places develop, the holes are filled in with earthbound gravel and the soft places are dug out and filled with good dry gob. The roadway is formed and smoothed with the auto patrol and crowned to fit the duowheels of the trucks and semitrailers.

The next step is to lay the seal coat. All traffic is routed away from the roadway, which is then made smooth by the roll and auto patrol. The road is sprinkled lightly with a

* Presented at the 18th Annual Coal Convention and Exposition. the American Mining Congress, Cincinnati, Ohio, April 30, 1941.

sprinkler wagon, if dusty, and the road is then shot with Walkers road oil and covered with a thin layer of coarse sand, just enough to cover the oil. This work is usually done over a week-end and in hot weather so as to allow the oil to soak into the gravels.

Traffic is again routed over the roadway for approximately a month. During this time, perhaps a week after the oiling, earthbound gravel in 1-in. layers is worked and molded onto the road surface by travel packing. No attempt is now made to smooth the road surface by scorifying so as not to break the oiled surface and all tractors with lugs are kept off the road. After two to three layers of earthbound gravel are molded onto the oiled surface the next and final step is to apply the top coat of oil, the wearing surface.

This coat of oil is applied in the same manner as the seal coat, except that it is covered with approximately an inch layer of pea gravel, minus ¾ in. by plus ¼ in.

Freezing and thawing is severe on heavy-duty coal haulage roads. For maintaining in the winter season it is necessary to use ¾-in. crushed limestone on the road shoulders and tire paths. Pea gravel is used for filling in small chuckholes as they develop.

Road Building at the Red Ray Mine, Freeburg, Ill.

Last summer it was decided to revamp the haulage equipment at the Red Ray mine of the same company, and to substitute truck haulage for steam and rails which had been used

Pneumatic tired roller used to smooth sheepsfoot tracks

for a number of years. The new type of equipment to be used made it necessary to provide haulage roads where they had not existed previously.

In making the investigation to determine which type of road would be the most desirable there were much information and data available, none of which seemed entirely adequate for satisfying the conditions encountered. After much discussion, stabilization with emulsified asphalt was finally decided on as the type of construction for the trial stretch.

In preparing for the changeover, the route selected from the pit did not correspond to the trail that had been used by the steam locomotives, and it was therefore necessary to make a new cut which, although graded and filled, still left an uncompacted base. It was subsequently decided to construct a section of emulsified asphalt stabilization, another of mechanical stabilization, and to use raw gob where the trucks were to run on the coal bed. The total distance to be worked was about 1 mile. Of this length, 600 ft. were to be stabilized in accordance with recommendations made by the Bitucote Products Company for a serviceable road. The recommendations for this section were a 6-in. mechanically stabilized base of mine gob and clay in the proper proportions, thoroughly compacted and cured, and an additional 6-in. depth of the same aggregate stabilized with emulsified asphalt, also thoroughly compacted and cured, and a double seal coat of emulsified asphalt and stone chips. The balance of the fill was to receive a layer of mechanically stabilized gob and clay laid at random depth, but approximately 6 in. to 8 in., throughout the distance, to be followed by a double seal coat of emulsified asphalt and chips. It was assumed that raw gob, dumped on the coal over which hauling was to take place, would be sufficient to cushion the coal bed from any fracture that might be caused by the haulage equipment. No seal coat or compaction was contemplated on this section.

The time selected for this work was the period beginning the latter part of August. The weather at that time was dry, as it had been for some time before, and conditions were considered favorable for the work. In preparing for the job the following equipment and materials were brought to the location ready for use as required:

1 LeTourneau pull scraper, approximately 15-cu.-yd. capacity.
1 Motor patrol grader.
1 Pull grader.
1 Tractor.
1 Sheepsfoot roller.
1 Flat-faced roller.
1 Rubber-tired multi-wheel roller.

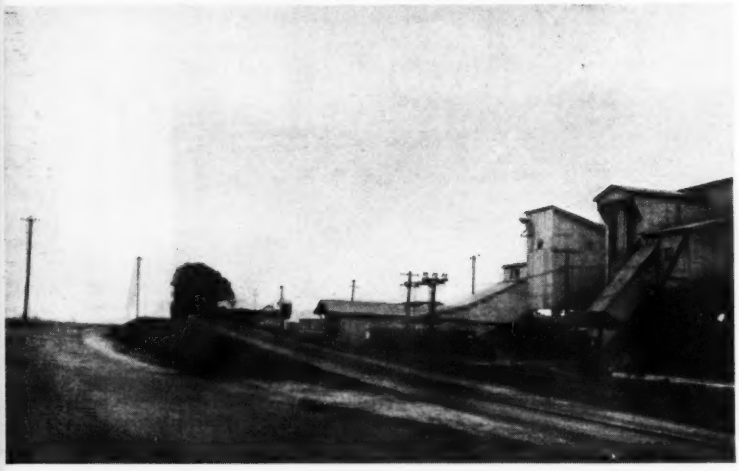
The emulsified asphalt stabilizer diluted with water being applied in proper quantities based on gallons per square yard

1 Sprinkling wagon.
1 Emulsified asphalt distributor.
Carloads of washer gob from the Fidelity mine of the United Electric Coal Companies, at DuQuoin, Ill.
1 Tank-car load of Bitucote emulsified asphalt stabilizer.
Stone chips for seal coat, trucks and stone spreaders.
2 Tank cars of Bitucote emulsified asphalt for seal coat.

Method and Procedure

Gob was spread on the road and clay, typical of this section, picked up from an adjoining bank and which, upon being tested, was found to have suitable characteristics for this type of work, was blended with it to give 15 percent clay by weight. Enough of this was spread to give a depth of 6 in. when compacted and 34 ft. width. Water was added by sprinkler wagon to facilitate mixing, and the material mixed thoroughly with motor patrol. This was allowed to dry to predetermined optimum moisture content and then compacted to the maximum density with a sheepsfoot roller. After this layer had been opened to traffic to allow for further drying, a second layer was laid in the same manner as above, with the addition of Bitucote emulsified asphalt. This was added through a pressure distributor, diluted with an equal quantity of water at the rate of 2¼ of undiluted emulsion per square yard for the 6-in. depth. This gives 4.5 percent emulsion by dry weight of mix, or 2.6 per cent asphalt

Showing finished road after double seal coat and chips have been placed and rolled. Road in service under normal conditions



General view of truck dumping at tipple—note dust-free surface and smooth hauling track

cement. The total amount of water added was about 20 percent. This material was mixed as before with a motor patrol and, after curing to the optimum moisture content, it was compacted with the sheepsfoot roller to the maximum density. This was then rolled with pneumatic-tired roller to obtain a smooth surface. The road was then opened to traffic and allowed to dry out further, for at least two weeks, when the moisture content should be below 5 per cent.

Following the procedure outlined above, which covers the 600 ft. constructed in accordance with the formula furnished by the Bitucote Products Company, the balance of the road was given the random layer of mixed gob and clay compacted and opened to traffic shortly after the asphalt stabilized section. It was decided that the possible benefits of a seal coat could best be demonstrated by treating the entire length. When the road was ready for the seal coat it was swept clean of all loose material and, where the surface was dusty, it was sprinkled lightly with a sprinkler wagon just enough to dampen it. Then the road was shot with 0.25 gal. of emulsion per square yard and covered with ⅜ in. to ⅛ in. stone chips at about 15 lb. per square yard. This was rolled with a 5-ton roller and the process repeated, giving a total of 0.5 gal. of emulsion per square yard and about 30 lb. of chips. This was given a final rolling and then opened to traffic.

Results Obtained from this Type of Construction

When the construction of the base in the entire length was completed, it was noted that the emulsified asphalt section presented a smooth, hard, very serviceable surface but was inclined to dust slightly from abrasion. On the mechanically stabilized section the same condition existed, but to a greater degree. The raw gob on the coal compacted and held shape as well as could be expected. All of this was no doubt true because of the extremely dry weather that existed in this area from the time the project was started until quite late in the fall.

After the seal coat was added to the full length of the stabilized section, the performance was uniform throughout all of the area until the rains set in. With the advent of wet weather the first failure was noted in the raw gob on the coal bed. This made a sloppy mix that had to be cleaned off of the coal as quickly as possible, as the trucks were inclined to sink and slide where any depth of the gob occurred. As the rain continued and some freeze and thaw were encountered, the seal coat had started to peel on the outside edges of the mechanically stabilized section, making it necessary to patch frequently with fresh rock in spots where failures occurred. There was apparently no failure in the asphalt stabilized section at this point. Similar failures have continued until the present time, but the emulsified asphalt stabilized section remains smooth, free of chuckholes, waving, or other evidences of failure.

The mechanically stabilized section can be kept serviceable by continuous patching and the emulsified asphalt stabilized top can be added during the coming idle season to give a road equally as serviceable as the emulsified asphalt stabilized section. The cost of working and maintaining the mechanically stabilized section will, therefore, not be lost in adding the emulsified asphalt stabilized top. In other words, the mechanically stabilized section will serve the same purpose as the 6-in. base under the 600 ft. of emulsified asphalt stabilized surface that is performing well.

There has apparently been no harmful results from hauling over the bed of coal but, if some protection is desirable for this surface, a single 6-in. layer of emulsified asphalt stabilized material would be ample protection. A relatively high crown and proper drainage are all that would be necessary.

Each Road Job Presents a Separate Problem

To comment further on the above construction, it is our opinion that a definite formula should be set up on each job undertaken. This would be based on the physical characteristics of the available clay, the gradation of the gob, and the results of the absorption and stability tests on the blended mix. Such a formula would indicate the exact qualities of each of the above materials which would be obtained locally and, in most cases, without cost other than manipulation. The proper quantities of emulsified asphalt stabilizer, together with carefully supervised construction to insure maximum density by compaction at optimum moisture content, should give uniform results throughout the job and satisfactory heavy-duty haulage construction. A road of this type can be constructed to handle any haulage problems that exist at a coal mine. The pavement would necessarily be varied in depth, width, crown

and grade to meet the requirements of the job for which it is intended.

I would like to thank Messrs. Herman Ehlig and Charles Warriner, of the Bitucote Products Company, for their assistance and cooperation in preparing this paper.

Laboratory Tests Determine Suitability of Local Road Materials

The accompanying laboratory report indicates the results of tests made from samples taken from the Red Ray mine at Freeburg, from which the design of the stabilized mix is determined.

The following will explain the characteristics that are reflected by these tests:

The test samples when brought into the laboratory are dried and the gradation for size of the gob and clay separately are taken. The results are reflected in the first two columns under "Grading." Then for a tentative beginning, a mixture of 80 per cent gob and 20 per cent clay is made and checked against ideal specifications. This is reflected in the last two columns under "Grading."

Soil characteristics: The figures shown here are helpful in determining the bonding quality of the available clay. These figures will vary on soils ranging from sandy loam to very highly plastic clays.

At this point 12 cores of mixed material are made up, 3 of them without treatments of any kind, asphalt or otherwise—just the clay and gob, the proportions indicated under "Grading" as approaching ideal gradation—in this instance, 80 per cent gob and 20 per cent clay. From the same mix, three cores are made up containing 4 per cent of emulsified asphalt stabilizer, three containing 5 per cent of stabilizer, and three containing 6 per cent of stabilizer. These are compacted and cured in the same way the test section at Freeburg was compacted and cured on the road. Then they

BITUCOTE PRODUCTS COMPANY—LABORATORY REPORT

Base Stabilization

Lab. No. ———

Date sample received: 1-30-41
Date tests reported: 2-15-41

Material: Coal mine gob and local clay.

Sampled By Warriner.
From road and bank.

Date: 1-30-41.
Location: Red Ray mine.

Pct. passing sieve	GRADING Gob	Clay	80% gob, 20% clay combined	Specification
1"	100	...	100	100%
¾"	87.2	...	89.6	75-100
½"	...	...	...	65-100
⅜"	71.7	...	77.6	.....
No. 4	55.7	100	64.6	45-85
10	37.2	99	49.7	35-75
40	17.9	90	32.3	25-45
80	13.6	86	28.1	17-35
200	11.6	83	25.9	15-30

Soil characteristics (on material passing No. 40 sieve)

Liquid limit	25.0
Plastic limit	20.2
Plastic index	4.8

		Test No.	1	2	3
Absorption test: Pct. water absorbed in 7 days (Pct. stabilizer based on total grading)		Untreated	17.2	17.2	17.3
		4% Stab.	1.28	1.28	1.26
		5% Stab.	1.09	1.12	1.07
		6% Stab.	1.36	1.06	1.08
Stability tests (Pct. stabilizer based on total grading of aggregate)	Untreated	Bottom ½"	1200	1200	1200
		2nd ½"			
		3rd ½"			
	4% Stab.	Bottom ½"	23000	22400	22600
		2nd ½"			
		3rd ½"			
	5% Stab.	Bottom ½"	25400	24400	25000
		2nd ½"			
		3rd ½"			
	6% Stab.	Bottom ½"	21600	26600	24400
		2nd ½"			
		3rd ½"			

were exposed constantly to water for a 7-day period. The results are as indicated. That is, the various samples absorbed the percentage of moisture shown and the three trials are to to check possible variations made necessary by working on such a small scale. From this test, so far as absorption is concerned, 5 per cent stabilizer would seem to be the ideal treatment.

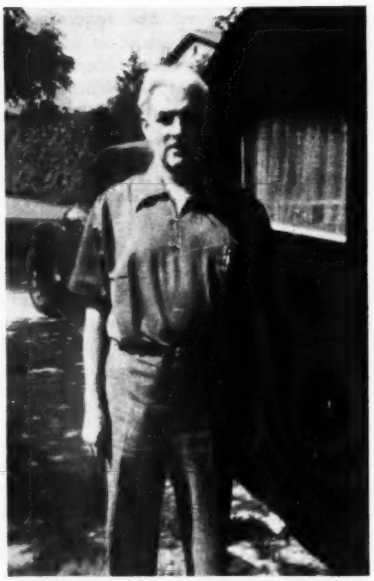
In the last series of tests the same sample cores are subjected to sufficient pressure to break the first ½ in. representing bearing surface. This would further tend to verify the 5 per cent stabilizer as being ideal in this instance.

It is interesting to note, in both the absorption and stability tests, the striking difference between the untreated samples and any of the treated samples. A complete laboratory report, such as the above, for each individual job is absolutely necessary in order to eliminate the possibilities of failure from guesswork when large-scale operations are attempted.

Above: Mechanically stabilized sections. Note standing puddles, evidence of softness; and fresh rock patching at sides, showing tendency to chuck-holing

Above: Emulsified asphalt stabilized section. Note apparent strength and unmarked surface

Fundamentals in the Search for BERYLLIUM



The author has spent much time visiting mining centers and making mineral identifications. As a result of that work he gives us some common sense and pertinent observations regarding beryllium and its ores, to guide those who would look for the minerals of this element, the importance of which is rapidly increasing.

By PAUL H. M.-P. BRINTON
Professor of Chemistry
University of Southern California

Above: The author with his trailer outfit which he uses in his field work

THERE is so much misinformation about beryllium, and so much effort and money are wasted in following fantastic notions about the ores of this element, that a brief discussion of some important fundamental facts may lead to saner methods of search for deposits of these ores.

Beryllium a Valuable Alloying Element

There can be no question about the great value of beryllium as an alloying metal. The effect of this element on copper is common knowledge, and this phase of the question need be dealt with only briefly. Copper, with a Brinell hardness of 50, is too soft for many purposes. By alloying copper with one per cent of beryllium the hardness is raised to about 75, and additional amounts of beryllium further increases this hardness, so that a five per cent beryllium-copper alloy shows a Brinell figure of about 320. Perhaps the most important fact about this hardness is that the figures just given are those for the soft, annealed alloys. Pure copper cannot be hardened by thermal methods, while the hardness of the beryllium alloys can be carried much higher by suitable heat treatment. This gives the great advantage that the alloys can be machined in the softer state, and the finished product can be heat treated and greatly hardened for final use.

Heat treatment also increases the electrical conductance of the alloys, and while this property is naturally not as high as in the case of pure copper, yet the electrical conductance of beryllium-copper alloys is considerably higher than that of such alloys as phosphor-bronze and other alloys which have sufficient strength and elasticity to serve in electrical connections. The heat-treatability of these beryllium copper alloys is very valuable in connection with tensile strength, for a 2.5 per cent beryllium alloy which has a tensile strength of 60,000 pounds per square inch in the soft, cold-rolled state, is raised to 175,000 pounds per square inch by heat treatment. If we compare these figures with 33,000 pounds for pure copper, the enthusiasm of some of us for the future of beryllium may be understood.

Beryllium Alloys Have Many Uses

The high modulus of elasticity, the resistance to fatigue and to torsion strain, all these taken in connection with the properties just discussed, indicate a series of alloys ideally suited to use in electrical clip, pin, and spring connections. Experiments conducted with high-temperature electrical connections, such as those in laundry irons, and in circuit-breakers that are subjected to long periods of great heat, show that beryllium-copper connections give many times the length of life obtainable from other alloys.

An interesting example of the superiority of beryllium-copper alloys over steel has been found in the firing-pins of revolvers. Enthusiastic target shooters put a great strain on the firing-pins by repeated snapping of the empty revolvers in so-called "dry practice." The gradual elongation of the pin leads to final rupture. Pins of beryllium-copper were found to last two or three times as long as those of steel. Also to be mentioned are the non-sparking tools, such as screw drivers, hammers, pliers, etc., which, while much more expensive than those of steel, are justified in cases where a spark from a tool might cause an explosion.

These copper alloys have so far been found to be the most important, but considerable work with alloys with other metals has led to the conclusion that the future will see beryllium used in a wide variety of alloys. In Germany some use has been made of beryllium-nickel alloys, which have been found to be very strong.

Beryllium oxide is a refractory of outstanding quality, and for cases of severe use at high temperatures, such as crucibles for the melting of platinum, this oxide has been found superior even to those of magnesium and thorium. The resistance to mechanical and thermal shock is very high.

Other uses of beryllium, suggested and actual, must be passed over in the interest of brevity. It is interesting to note, however, than an entirely new use for this element is suggested by recent experiments in England, which go to show that a coagulating bath of beryllium acetate has been found superior to all others in the manufacture of a new textile fiber of the rayon family, made from seaweed.

Let us assume, then, that on the basis of its usefulness, the future of beryllium is assured. It is felt by serious students of the subject that but few exaggerations have crept into the literature, both popular and scientific,

as to the value of beryllium in finished products. Beryllium has, we believe, the almost unique distinction of not yet having been widely suggested as a therapeutic agent.

Misconceptions Have Arisen Concerning the Prevalence and Occurrence of Beryllium Ores

But when it comes to claims as to the supply of beryllium ores, and to the existence of high percentages of beryllium in huge dikes of country rock, the claims of the most gaseous-headed gold prospectors and promoters pale into insignificance. It is in connection with the occurrence—with the source of supply of beryllium, that certain important fundamentals need to be stressed in order that the search for ores of this element may be carried on in a sensible and well ordered way.

The ores that one hears most about are beryl, a beryllium-aluminum silicate, which, in its state of highest purity, contains 14 per cent of beryllium oxide; and phenacite, an orthosilicate of beryllium, which would contain 45.55 per cent of the oxide if the mineral were entirely pure. Now the thing that makes phenacite so greatly desired is not only the high beryllium content—about three times that of beryl—but the fact that there is no aluminum present. Separation from aluminum contributes immeasurably to the difficulty and cost in the recovery of beryllium from its ores.

Phenacite, unfortunately, is a very rare mineral, and up to the present time it has had value only for the cabinets of mineral collectors. Until phenacite has been shown to be something more than a rare cabinet specimen material it may safely be disregarded as a commercial source of beryllium. But prospectors and promoters refuse to be impressed by the rarity of the mineral, and when my telephone rings now, the chances are that the name of phenacite will crop up before the conversation is over. Many a prospector has come to my office with a sample of nondescript rock, and states that the content of beryllium oxide has been found to be somewhere between 20 and 40 per cent. When I call his attention to the 14 per cent maximum for beryl, he looks at me with a superior smile, and breathes the inspired word "Phenacite." It is difficult to understand where the craze for calling quartz "phenacite" started, but it has a tremendous hold on the American mining mentality. It is not only among comparatively untrained prospectors that we find this tendency, but among highly educated mining engineers as well. Rather recently a graduate from one of our best mining schools engaged air passage to a foreign country to start exploitation of a large field of phenacite—great crystals, he told me, all over the extensive outcropping. It was merely by accident that a piece of the material came to me for examination before he started on his trip. It was a very beautiful crystal of pure quartz, with no trace of beryllium in it. This sample, had it been phenacite, would have been worth a thousand dollars as a specimen, and one might expect a trained mining engineer to know that crystals of this value are not scattered broadcast over the face of the earth. It is quite true that phenacite and quartz are difficult —in many cases almost impossible—to distinguish from each other by simple visual inspection. Accurate crystal measurements and microscopic investigation will certainly reveal the difference to the trained mineralogist, but it is extremely doubtful that any ordinary prospector, or practical mineralogist, can distinguish between phenacite and quartz when the two are placed in his hand. So the difficulty of distinguishing the two is not to be minimized. None the less, one might wish that trained mineralogists, and even experienced promoters, would realize the rarity of some of the minerals, and not call every bright, shining stone, phenacite. Literally hundreds of samples have been sent to the writer as phenacite, and, with one single exception, every one has been found to be quartz. It later developed that the one exception had been obtained as a loan from a well known collector, who would be expected to know.

While beryllium occurs in a number of minerals, such as gadolinite, hambergite and the alteration products of beryl (beryllonite, herderite and bertrandite), it is certainly premature to look to any of these as sources of commercial beryllium; for they, like phenacite, are as yet of interest only to collectors. Chrysoberyl, an aluminate of beryllium which contains about 20 per cent of beryllium oxide, is frequently mentioned in beryllium propaganda, but it must also be regarded with grave suspicion as a practical source of the metal. It is true that by virtue of its greater specific gravity, (3.7 as against about 2.7 for beryl), and its stability, chrysoberyl is at times found in stream beds, yet the occurrence is entirely insignificant in a practical sense.

Beryl is the Possible Commercial Source of Beryllium

So we are forced to the conclusion that beryl is the only mineral from which beryllium is likely to be extracted in commercial quantities. A second point of departure is that, so far, no beryl has been found in important quantities except in pegmatite formations. The occasional appearance of beryl in unusual surroundings, such as the pink beryl, morganite, which is found in rhyolite in the Thomas Mountains of Utah, and the emerald, and some less gemmy variety of beryl, that occurs in carbonaceous limestone in the Muzo mines in Colombia, in South America—these appearances contradict the statement frequently made that beryl can occur only in pegmatite. But the fact remains that from a commercial standpoint we have relied upon, and probably must continue to rely upon pegmatite beryl as our source of supply for this valuable metal.

Deposits Cannot be Worked for Beryl Alone, at Present Prices

The price of beryl, $30 to $35 a ton, f. o. b. at the quarry districts, is unfortunately so low that the hand sorting necessary to prepare it for shipment makes it almost impossible to work a dike for beryl alone. Only if other minerals, such as mica or feldspar, can be produced at the same time will the beryl pay. This does not hold in India and South America, where labor costs are so low that hand-cobbing presents no economic barrier to profits. The fact that most of the beryllium produced in this country comes from Argentine and Indian beryl is not so much an indication of superior deposits in those countries, as it is a reflection of lower labor costs.

Many persons fail to recognize the spotty nature of the occurrence of beryl, and one hears many reports of huge ore masses which will run such and such a percentage of beryllium oxide. The fact is that in the best beryl occurrences we may find a part of the dike which has a considerable amount of the mineral in it, and then we may run a long time through feldspar and quartz that is almost barren, as far as beryl is concerned. Then another good occurrence of beryl may be encountered.

Future Prospects Are Good

This sketch of the mining prospects for beryllium is in drab contrast with

(*Continued on page 55*)

Berthoud Hall, Colorado School of Mines. Devoted entirely to laboratories for geological and geophysical work

The Trend of Applied MINING GEOLOGY

By JAMES BOYD
Associate Professor of Mining Geology
Colorado School of Mines

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Mr. Boyd points out that mining geology has not been applied to the problems of discovery of new ore deposits as intensively as has geology been employed in the corollary field of petroleum exploration. At present the discovery of new ore reserves is rapidly falling behind production; this situation must be corrected if the country's future well-being is to be insured.

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ONE who is responsible for the geological training of many young mining engineers has more than a passing interest in the recent articles of Messrs. I. B. Joralemon * and Reno Sales.† To me these men represent the extremes of thought in the field of applied mining geology today. At one extreme is Joralemon who, through the greater part of his paper, expresses the viewpoint of most exploration companies; that is, as expressed in the practice of using experienced geologists to go hurriedly from one prospect to another and, on the basis of not more than two or three days' examination, recommend them for further exploration or condemnation. Taking the opposing view is Sales, who represents the form of detailed mining geological investigation that has proved so important in large-scale mining operations. Between these limits, however, is a broad field in which the uses of applied geology have been badly neglected and in which the greatest amount of work remains to be done. It is here that I feel sure a great deal of missionary work can be usefully carried on.

The fact that Sales does not entirely agree with Joralemon's method of attack does not mean that the economic geologists are not generally in agreement with the interpretation of the fundamentals of their profession, but it does mean that their field has been so neglected by industry as a whole that there are many gaps which have to be filled and which can only be filled when the mining industry uses the science to its fullest advantage.

In Exploration for Petroleum Deposits, Geology Has Been More Intensively Employed

A very striking analogy can be drawn to illustrate the point; that is, in the petroleum industry, which is closely related in many ways to mining and in which geology has been most fully employed. The history of petroleum exploration is well known to those engaged in mining, but a review is timely, to draw some parallels with the growth of mining geology.

In the early days of the search for oil, wells were drilled only where it was indicated by seeps at the surface. Although this method of oil-well location was a rudimentary form of applied geology, it took no geological training to recognize oil seeps; neither did it take expert geological talent to recognize obvious metalliferous deposits where they outcropped at the surface. But when all the known oil seeps had been prospected there had not developed a geological philosophy for further prospecting, and a hit-and-miss method of wildcatting developed in which holes were drilled almost indiscriminately, whenever a promoter could raise sufficient funds to sink a well. The large operating companies then took advantage of the discoveries so made to obtain their production, and even took some part in this type of exploration themselves. A parallel stage in mining is that described by Joralemon, in which operating companies in their search for mines place their dependence on the relatively uneducated miner, who, without proper guidance, is opening prospects all over the country. It is these prospects that the expert engineers are "dashing about to look at in their inimitable hurried way," as illustrated by Joralemon: "A published record of a great Canadian exploration company that examined 2,000 prospects and did not find one worth spending a nickel on. . . ."

Here, with but few exceptions, the petroleum industry has left its con-

* Joralemon, I. B., "Mining Geology Today," MIN. CONGRESS JOUR., December, 1940.
† Sales, Reno H., "Mining Geology Today and Tomorrow," MIN. CONGRESS JOUR., Jan., 1941.

temporary far behind, for with a clearer knowledge of the geological conditions which favor the concentration of oil, as first expressed in I. C. White's "anticlinal theory," they had definite problems on which to work. When the value of these theories was realized, the oil companies employed more geologists in a period of 10 years than mining has in its entire history. Organized into field parties, these geologists searched virtually the entire face of the North American continent and much of the rest of the world for surface evidence of underground structural traps, and no reputable company would drill a well until all the geological relationships had been carefully worked out. But in the United States today virtually all this work has now been done, and it can safely be said that there are no surface evidences of structural traps that have not been carefully studied, if not explored. This, however, did not spell the doom of geological exploration, because it became necessary to employ the geologists on a host of other problems involved in operation and in the search for deposits which have little or no surface evidence. Here geophysics came into the picture as a geological tool as important as the planetable and alidade had been in the early days. But even after the oil pools were discovered the geologist's work did not cease; he had to be continually on the job assisting in solving operating problems and in making sure that other producing horizons in the same structures had not been overlooked. This year there are more geologists at work in the oil industry than there ever were in the days of widespread surface exploration.

Geologists Have Prolonged the Life of Mining Districts

Can a more striking parallel be found than in the excellent work of Sales and his assistants at Butte? This district was not found by the geologist, but there is no doubt that without the geologists' services the district would have been dead long ago. His purpose is not only to discover new ore shoots but to outline the known orebodies so that they can be properly developed, to locate shafts in the best place for efficient operation, to maintain production at the economic level, to indicate channels of water flow so that it can be properly controlled, to predict movement and caving so that it can be controlled or prevented before the still unworked orebodies are destroyed. These are just a few of the daily problems confronting the mine operator that can be solved scientifically only by the geologist or geologically trained mining engineer. Except, however, for a very few of the larger companies and isolated smaller properties, little reliance is placed on geological work as such.

This same condition existed in the petroleum industry until very recent years. The same skepticism was evidenced, and geology was used directly very begrudgingly, but I venture to say there is no successful oil company today, large or small, that does not either employ its own geological staff or draw liberally on the advice of consulting geologists.

Mine Managements Generally Do Not Employ the Science to the Fullest Degree

Why is it that the mining industry is so far behind in its use of this valuable science? I believe that it is mainly because the engineers in charge of operations in many cases do not realize how much they are using it subconsciously, and prefer to continue to apply their own limited knowledge of the subject in preference to spending a small amount of money on an adequately trained specialist and giving that specialist a chance to become familiar with the details of his deposit. If they reluctantly call in a geologist when difficulties are encountered, they expect him to come to the district and their mine and give a profound and studied answer immediately, without the expenditure of much time or money; and yet this operator would drive a crosscut of ten, a hundred, or even a thousand feet on a "hunch" at a cost sufficient to pay the expenses and salary of a geologist for the entire life of the mine. Would he make a change in his mill without the assistance of a metallurgist, making a careful study of all the factors involved, and without careful testing? Surely not.

The lack of the realization that mining geology has progressed in the last few years to a workable science is fully expressed in a recent letter to the editor of the MINING CONGRESS JOURNAL *: "Here is a challenge, to those who believe as he (Sales) does, to go out and find a Comstock Lode hidden by insufficient or excessive erosion. The theory of probability indicates that some such undiscovered orebodies exist. But I am not aware that geologists have discovered any large districts. The reason is clear. Mining capital recognizes that such search would be very speculative and will not risk the money. . . . The conclusion inevitably is that geological exploration is still highly speculative." But it is no more speculative for the industry as a whole than the present method of having a number of companies spend an enormous amount of money sending out expensive geologists and engineers to examine the same prospects time and time again. I venture to say that today every prospect in the United States and Canada that has any semblance of merit has been examined a number of times, until the field has been dried up. The discovery of new ore reserves is rapidly falling behind production under this system, whereas in the oil industry, more scientifically directed, the annual discovery of new reserves exceeds the production.

Naturally a great deal of money is needed for this type of exploration, and this is the underlying reason why the geologists have not found a Comstock Lode; they cannot do it alone, and, as Mr. Neal points out, they have not been given the opportunity of mining capital. In its search for "strategic minerals" the United States Government has been and is doing some of this type of work, but is the mining industry going to allow the encroachment of Government control through this channel because of lack of action on their part? The petroleum industry did not have to and has pointed the way. If a highly speculative oil prospect is discovered and any one company feels that it cannot afford to handle it alone, two or more of them pool their holdings and drill a well jointly so that if it fails no one company has been hurt too much. There is no reason why mining companies who have cooperated in production combinations in the past could not as easily cooperate in a scientific search for virgin deposits.

Geological Successes Are Not Publicized

There are other reasons why geology is not being applied as it should be. The main one is that the successes of geological work are not properly made public for obvious reasons; first, because the operating company does not normally wish to have its secrets divulged; and, second, because many operators are reluctant to admit that they failed to see something that appears to be very simple when explained by a geologist.

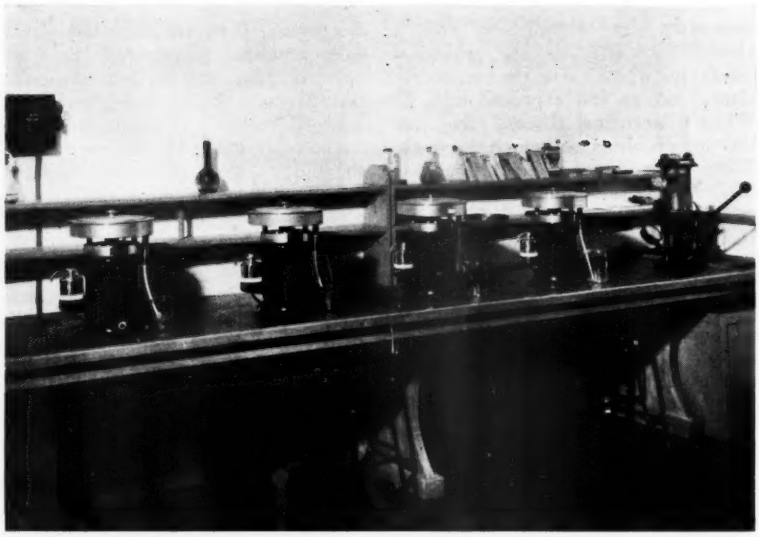
An example of this type of reason-

* Neal, Homer C., To the Editor, MIN. CONGRESS JOUR., p. 58, March, 1941.

ing will illustrate it much more clearly. A well-known and excellent mining engineer in Colorado, who was operating a moderately large mine, lost his vein against a fault. At a loss as to which way to turn, he asked a government geologist, who happened to be in the district, to help him. It took this geologist just five minutes to point out that the fault was premineral and that all he had to do was to drive straight ahead to find ore again. The answer was so simple when it was pointed out that the mining engineer felt it was a reflection on his ability not to have recognized it himself and became annoyed when the case was given some publicity. What he did not take into consideration was that the geologist knew the answer only because he was widely experienced in the field of geology and had a working knowledge of the detailed geology of that district. The only reflection on that engineer was that he failed to recognize the importance of knowing the detailed geology of his property, and did not have either a consulting geologist or one man on his staff who was allowed sufficient time from his other duties to be acquainted with these problems.

One of the main obstacles to the realization of the importance of geological work in mining operation is the fact that much detailed study is necessary in the beginning of the work, during which period no apparent results are noticeable; but when the principles are applied successfully, the answers become so apparent that the average man fails to appreciate the amount of preparation essential to give those answers correctly.

Sales has pointed out clearly that these discussions by geologists are not to sell jobs for mining geologists, but that the importance of geology must be comprehended in order to preserve the great mining industry of this country. The petroleum industry came to this conclusion when it realized that its reserves were rapidly being depleted and that there was no other way to perpetuate that industry. Today in this country our reserves of ore are being depleted much more rapidly than they are being discovered. Many mines are being closed for supposed lack of ore, and when that happens there is very little likelihood of their ever being opened again; consequently, ore which might have been discovered during operations will be lost for all time. It is usually too costly to reopen a mine in order to solve problems that should have been solved while the mine was working and the exploration costs were lower.



A corner of the polishing room, where ore specimens are polished and prepared for microscopic examination

Some large mining companies, particularly those having low-grade deposits, feel that the services of a geologist are superfluous, that the ore is there, and that ends the matter; but actually we may be touching only the cap of large unsuspected commercial deposits.

An illustrative condition has already come to light in the molybdenite orebody at Climax, which through early exploration on the upper levels was shown to be uniform and pipe-like with a large central barren area. But, through subsequent development work and geological investigation it is now known that the orebody is more in the shape of an inverted bowl, and that apparently it is related to a stock-like body of porphyry not well exposed at the surface. In addition, at an intermediate depth there has been discovered but not yet fully developed an unexpected orebody, somewhat similar to the first, underneath the central barren area. It is altogether conceivable that undirected development work without the assistance of geological investigations might have missed this lower body entirely and that the deposit would have been abandoned when the upper bowl-like deposit had been worked out.

Small Operators Feel They Cannot Afford Specialized Geological Service

On the other hand, it has been stated that small operators cannot afford the services of a geologist. It seems to me that, with the exception of some very especially simple properties, they cannot afford to do without it. The operations of too many small mining properties contain evidence of the lack of geological study; one can find ill-advised development work, such as hundreds of feet of crosscuts, where a few tens of feet would have accomplished the same result. Since I have been discussing this subject with many men active in mining, more and more examples are pointed out to me each day. Most of these are unsuspected by the operators, as they are unable to realize that a little geological work would, in many cases, have saved the money wasted in useless development.

In expressing these views I have been accused of disparaging the mining engineer, but that is by no means my intention. Few operating engineers today will attempt to run their own mills without the advice of competent metallurgists, if not with their full-time cooperation; why, then, should these engineers feel capable of dealing with the equally puzzling features of geology?

The progressive educators of mining engineers have realized the indispensability of geological training and have made it an appreciable part of the course of study. Few oil companies feel that a four-year course is sufficient training for a competent geologist and usually demand a period of graduate study before they will accept him into their geological departments; but the problems of petroleum geology are relatively simple as compared to those faced by the mining geologist. No mining engineer should feel incom-

petent when he admits the necessity of seeking technical geological advice, because he is expected to be adequately trained in a host of other engineering fields.

But, Joralemon states: "The majority of mines are comparatively small, and their margin of profit is low. If they hire geologists who spend months in a detailed survey of the mine and the district the ore found is likely not to pay for the cost of finding." In the first place, the geology of many mining districts has been studied and reported on by the Government surveys, and these studies can be utilized to shorten the time necessary for a detailed survey. In the second place, what causes the margin of profit to be low? Is it not partly due to the costs of exploration? How many small mines can you go into which do not have a blank crosscut here and there driven on a hunch, or in which the vein has been reached by a crosscut without careful consideration being given to the vagaries of the dip and strike and structure of the deposit? Or if the development is in the form of a drift on an outcropping vein, how much consideration has been given to the position of the ore shoots on the basis of expert geological information? Or if the property is developed from a shaft, how many times has the shaft been placed in such a way that the cost has been more than it should have been to mine the ore shoots?

Now I do not say that a geologist could have anticipated all of these things and that he would not have recommended some development work that did not prove of concrete value. But if he could have saved as little as 50 ft. of unnecessary development work he could have paid for all of "the months of geological work." For, although many mining men will say that they can drift for $10 per foot, there are few that can do it for less than $20 when all costs are taken into consideration; and a very great deal of geological work can be done for the thousand dollars necessary to drive fifty or a hundred feet. Usually it is not necessary to spend this much money directly.

It still might be said, however, that a small mine cannot afford to import a geologist and give him time to become acquainted with the district and then do the local work on a specific mine. There are few districts that do not have several operations going on at the same time, in which a geologist could not be hired jointly to do the work for the group. This is being done with mining engineers in some areas where no individual mine has enough to keep a mining engineer busy with the one property alone. There are a number of things that the geologist also can do around any mine or group of mines other than the geological problem at hand which will help to support him and make him available for geological decisions when they are necessary. In one district in Colorado there are at present thirty-five mines in operation—and there have been literally hundreds of others like them since the Geological Survey report was written thirty years ago, in which no expert geological work as such has been done since. These mines are filled with abandoned cross cuts, raises, and shafts driven by operators who considered themselves sufficiently well versed in geology to dispense with the advice of geological specialists. Many of these ill-advised pieces of work have caused the failure of the operation by increasing the costs and eliminating the "small margin or profit"—a tragedy which could in many cases have been avoided by a bit of authoritative advice, given before the mine was looked at in retrospect.

The Services of Specialized Mining Engineers and Metallurgists Are Recognized

It should not be necessary to draw attention to the fact that not many years ago the practical miner looked with disfavor on the mining engineer; today the latter's advice is actively sought. The geologist is now in the former position of the mining engineer. Many mining engineers look on him as a dreamer and shun his efforts instead of using his scientific help and giving him the benefit of practical cooperation. With the great need for careful engineering in our modern mining methods, the services of a geologist are becoming as necessary to economic operation as were the services of the mining engineer toward the end of the Golden Age, when the high-grade deposits were beginning to disappear and more economical operation was becoming a necessity. Later the metallurgist became the profit factor in mining by squeezing a greater proportion of value out of ores of successively lower grade. Now it is the geologist who must come to the aid of the mining industry; and, as in all industries, the most successful men are those who anticipate the advances of science and apply them to their own business. So in the mining industry of the future the most successful will include to the greatest extent in their operation the benefits of the science of geology.

Minerals Valued at $5,600,000,000 Produced in U. S. in 1940

Stimulated by defense needs as well as by heavy industrial demands otherwise, the total value of minerals produced in the United States in 1940 reached the highest peak in more than a decade, according to estimates prepared by the Bureau of Mines and submitted in a report to Secretary of the Interior Harold L. Ickes by Dr. R. R. Sayers, director of the Bureau of Mines.

While almost all classes of minerals showed substantial increases in 1940 over previous years, the production of metals according to these statistics exceeded in value the total for every year in history with the exception of the World War years of 1917, 1918 and 1920.

The production of copper, lead, zinc, aluminum, iron, ferro-alloys, manganese, tungsten, mercury, titanium, cadmium, uranium and vanadium were all stimulated by the increase in industrial activity, and in some cases by the requirements of the strategic minerals stockpiling program.

The summary was prepared by the Bureau on the basis of preliminary data at a much earlier date than usual, in order to provide the mineral industries, defense agencies of the government and other interested parties with a working index of the industry as quickly as possible.

Some of the highlights of the report were as follows:

1. The estimated total value of all mineral products in the United States in 1940 was $5,600,000,000, or 15 percent above 1939.

2. The estimated total value of metallic products in 1940 was $1,650,000,000, or 28 percent above 1939.

3. The estimated total value of mineral fuels was $3,100,000,000, or 10 percent above 1939.

4. The estimated total value of other non-metals was $850,000,000.

5. The production of iron ore reached the highest on record, except for the years 1916 and 1917.

6. The value of the smelter output of copper and zinc from domestic ores increased 38 percent and 50 percent, respectively, while the value of the output of refined lead increased 16 percent above 1939.

7. The production of crude petroleum in 1940 set a new record.

8. The production of bituminous coal was the highest since 1930.

9. The output of coke was the highest since 1929.

10. Cement production in 1940 was 6 percent above 1939.

11. Platinum, molybdenum, chromite, anthracite coal, and phosphate rock were among the few minerals which showed a decline as compared with 1939.

Adequate Protection of Cross-Entry Trolley Wires—Increases Safety And Decreases Fire Hazard

● ***Circuit Breakers at Strategic Points in the Mine Protect in Cases of Excessive Heating and Shorting of Trolley Wires.***

By J. W. WIGHTMAN
W. A. HOLLAND
General Electric Company

A potential source of fire in every coal mine is a broken or grounded trolley wire. If the trolley wire in the cross entry breaks and the live end touches the ground, the resulting arc, if prolonged, is liable to start a fire. This is more likely to occur in the cross entry than in the main entry because such a break and ground in the main passage would undoubtedly cause an immediate clearing of the fault by the protecting breaker in the substation or power house, while in the stub-ended cross-entry trolley the short-circuit current resulting from the broken and grounded wire might not be of sufficient magnitude to trip the main breaker.

Therefore a circuit breaker inserted in the cross-entry trolley wire at its tap-off from the main trolley (or feeder) would serve not only to protect that particular cross entry from the hazard of fire, but would also, with the immediate removal of the short circuit, prevent excessive demand charges and eliminate the cost of energy wasted during partial short circuits of long duration. This is one of the most important points in favor of sectionalized switches or breakers. Furthermore, it reduces the likelihood of a complete shut-down in the rest of the mine, by cutting off the faulted section from the rest of the system.

Trolley-Wire Annealing Protection

As current flows in any conductor it naturally tends to heat, and if excessive current flows in a hard-drawn copper trolley wire it may cause the temperature to reach the annealing (or softening) value, thereby greatly reducing the tensile strength of the wire. See Fig. 2. Its own weight may then cause elongation and sagging, accompanied by a reduction of cross-sectional area, with increased heating (if the current continues) piling up the difficulties until the wire breaks.

Even if breakage does not occur from its own weight the reduction in tensile strength due to annealing has two undesirable features:

1st—It is impossible under the conditions to keep the wire taut;

2nd—Light rock falls will break the trolley wire, whereas if the wire possessed its original strength the rock-fall would very likely be shed.

Excessive slack in the trolley increases the danger not only to the material under the wire but also overhead, as the trolley-pole of the locomotive may force the wire up against combustible wooden cross timbers which might start a sustained arc to ground and thereby start a fire.

As shown in Fig. 2, annealing occurs at temperatures between 200 C. and 300 C. (392 F. and 572 F.). The length of time the annealing temperatures is applied, and the value of the proportional limit of the copper are important items. There are no precise data available on these values, but it would appear that about 200 C. (392 F.) is the *maximum safe operating* temperature of hard-drawn

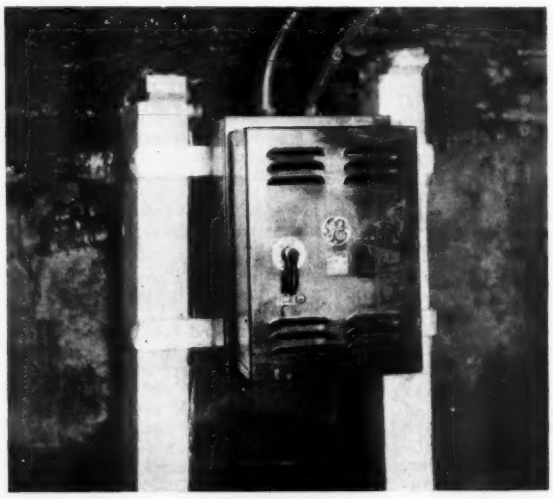


Figure 1. Air circuit breaker in coal mine

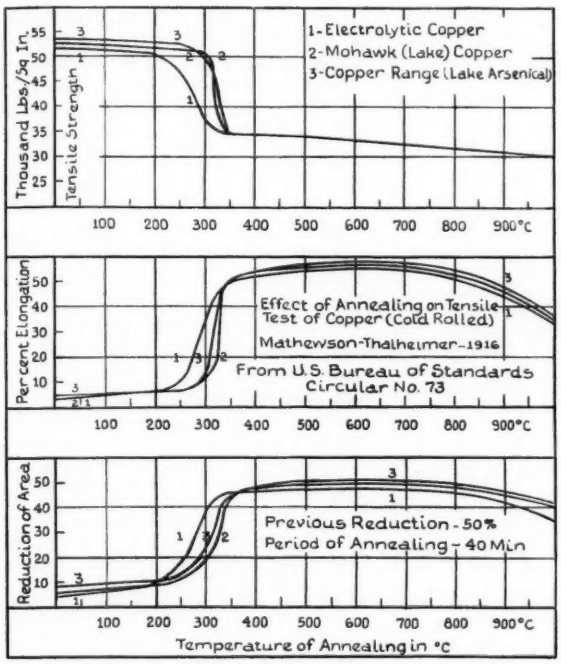

1-Electrolytic Copper
2-Mohawk (Lake) Copper
3-Copper Range (Lake Arsenical)
Thousand Lbs/Sq In.
Tensile Strength
Percent Elongation
Effect of Annealing on Tensile Test of Copper (Cold Rolled)
Mathewson-Thalheimer-1916
From U.S. Bureau of Standards Circular No. 73
Reduction of Area
Previous Reduction - 50%
Period of Annealing - 40 Min
Temperature of Annealing in °C

Figure 2. Curves showing effects of annealing hard-drawn copper wire

copper wire. Incidentally this is also approximately the maximum safe operating temperature for soldered joints.

Suitable Breaker for Protection

The problem is, therefore, to provide a protective circuit breaker which can be relied upon to trip at currents which, if continued, would endanger the trolley wire. Since No. 4/0 wire is by far the most commonly used size this is taken as typical and the conditions are shown in Fig. 3. The wire curve shows the time-current limits for a No. 4/0 copper wire, without exceeding 200 C., based upon an initial temperature at 70 C. in still air.

Even though the air in a coal mine is not "still air" the cooling effects of the air currents are neglected in the curves of Fig. 3 and 5. This procedure is on the conservative side and would increase the factor of safety of the curves.

The 500-ampere air circuit breaker recommended for the protection of the No. 4/0 trolley wire is equipped with a dual overcurrent trip which provides delayed tripping on currents in excess of the breaker rating up to approximately ten times the breaker rating, and instantaneous tripping for higher currents. The calibration setting or minimum ultimate tripping point, is adjustable from 100 per cent to 200 per cent (500 to 1,000 amperes) of the breaker rating. The lower curve in Fig. 3 shows the approximate time-current tripping characteristics of this breaker with the 100 per cent calibration setting. As will be seen from the curve the minimum ultimate tripping current is 500 amperes. The tripping time decreases as the current increases and instantaneous tripping occurs at approximately 5,000 amperes. It will be noted that the breaker curve remains consistently below the wire heating curve.

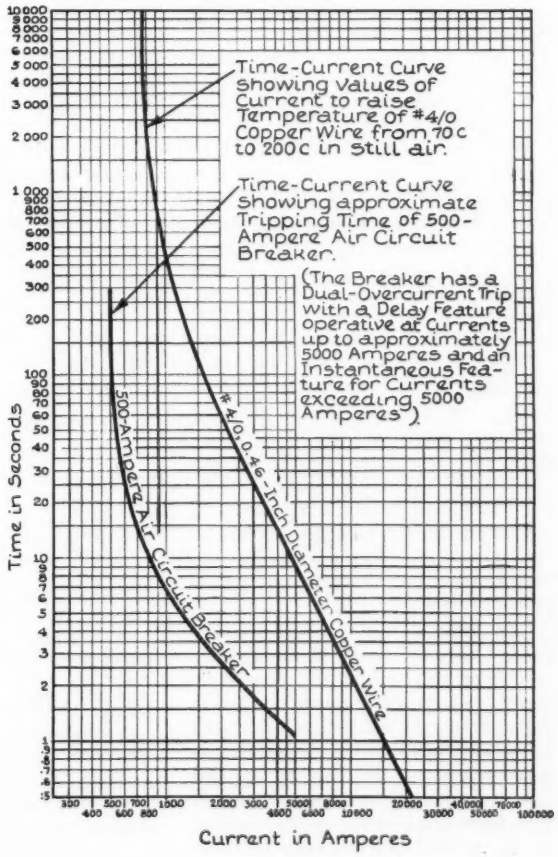

Time-Current Curve Showing Values of Current to raise Temperature of #4/0 Copper Wire from 70 C to 200 C in Still Air.
Time-Current Curve Showing approximate Tripping Time of 500-Ampere Air Circuit Breaker.
(The Breaker has a Dual-Overcurrent Trip with a Delay Feature operative at Currents up to approximately 5000 Amperes and an Instantaneous Feature for Currents exceeding 5000 Amperes)
500-Ampere Air Circuit Breaker
#4/0, 0.46-Inch Diameter Copper Wire
Time in Seconds
Current in Amperes

Figure 3. Time-current curve of No. 4/0 copper wire and 500 amp. air circuit breaker

These curves show the complete adequacy of this circuit breaker to protect the wire, not only to keep it from annealing but also to provide instantaneous tripping in case of short circuit. Of course, in applying the breaker the operating conditions of the circuit should be checked to make sure that the normal load surges are not of sufficient magnitude and duration to cause needless tripping. For example, the setting of the breaker must be such as not to trip on inrush currents due to the starting of a locomotive, plus the current which may be taken at the same time by cutting machines, leading equipment, etc. It should be pointed out that it would not be safe to set the breaker at its maximum calibration setting of 200 per cent because the annealing current of the wire is 740 amperes, which is only 150 per cent of the breaker rating.

Breaker Features

The breakers recommended for this service are sturdy in construction.

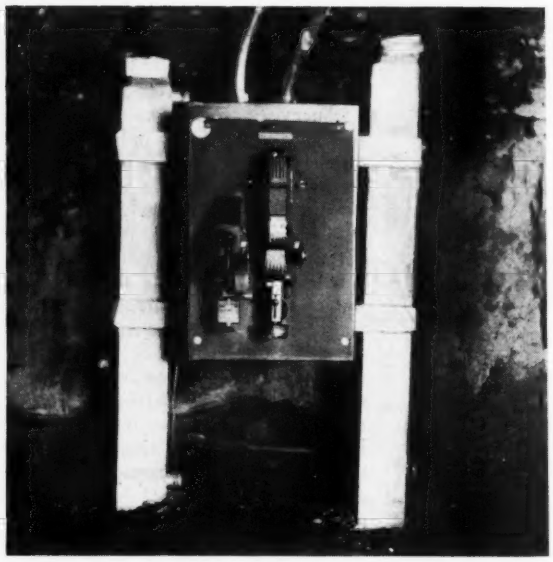


Figure 4. Air circuit breaker, 500 amp., 250-volt, AC for trolley protection. (Cover removed to show arc-quencher construction)

single-pole, manually operated, trip-free, and enclosed (see Fig. 1 and 4). The enclosure guards against accidental contact with any live breaker parts and the trip-free feature prevents holding the breaker closed against a short circuit. Both of these are safety features that assure protectection for the operating personnel. The breakers have an interrupting rating of 20,000 amperes, which is ample for any possible short circuit likely to occur within a mine.

They are equipped with silver-to-silver contacts and are therefore free from contact oxidation troubles even under the mining atmospheric conditions, even should the breaker remain continuously closed for long periods of time. Easily removable arcing contacts, of arc resisting silver alloy, protect the solid silver main current carrying contacts against burning assuring long life to the breaker. The breaker is equipped with an arc quencher consisting of an arrangement of metal pins within an arc chute above the arcing contacts. The arc is confined within this chute and is split up by the pins and cooled, so that the arc energy is rapidly absorbed, resulting in extremely quick interruption.

The breaker has a dual-tripping feature to provide the time overcurrent tripping characteristics shown in Fig. 3 and instantaneous tripping on short circuit at values exceeding ten times current rating. These are of great importance for this service and their advantages have been described. The time overcurrent device consists of an oil-film timer having two accurately machined surfaces in intimate contact and held together by the cohesion of a film of oil. Adjustment of time is made by a simple rotation of one of the surface members, increasing or decreasing the area of the surfaces in contact. This device is positive in its action, with inverse time characteristics as shown in Fig. 3. The timer is enclosed in a transparent container providing visible evidence of its condition (lack of oil or presence of dirt). Any dirt that might accumulate will not increase the time in opening, but will tend rather to diminish it.

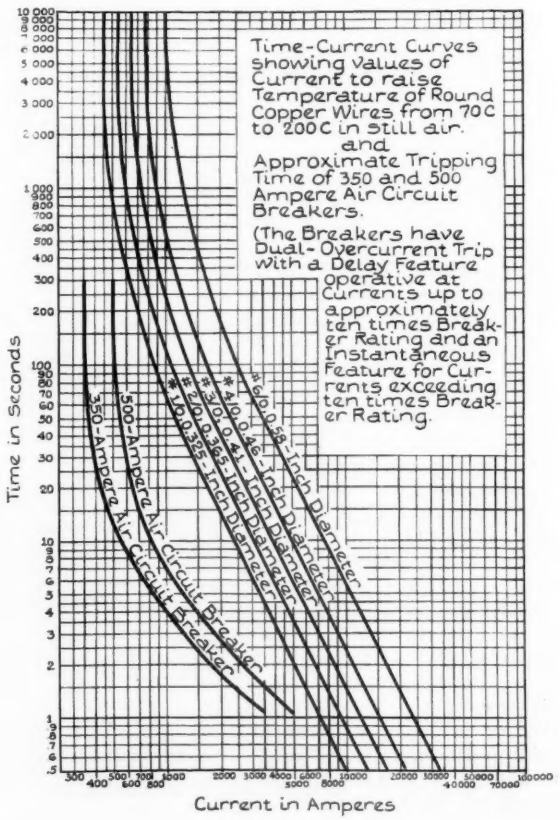

Time-Current Curves showing Values of Current to raise Temperature of Round Copper Wires from 70C to 200C in Still air. and Approximate Tripping Time of 350 and 500 Ampere Air Circuit Breakers.
(The Breakers have Dual-Overcurrent Trip with a Delay Feature operative at currents up to approximately ten times Breaker Rating and an Instantaneous Feature for Currents exceeding ten times Breaker Rating.
#6/0-0.58-Inch Diameter
#4/0-0.46-Inch Diameter
#3/0-0.41-Inch Diameter
#2/0-0.365-Inch Diameter
#1/0-0.325-Inch Diameter
500-Ampere Air Circuit Breaker
350-Ampere Air Circuit Breaker
Time in Seconds
Current in Amperes

Figure 5 Time-current curves of No. 1/0, 2/0, 3/0, 4/0 and 6/0 copper wire and air circuit breakers to protect them

If the breaker is to be mounted in a location of normal atmosphere free from moisture and gas a standard enclosed breaker, in a sheet steel box, painted with subway paint, can be used. This is the type illustrated in Fig. 1 and 4. If, however, the installation is to be in a location where there is moisture or dripping water a weatherproof housing is used. In some cases a small (60-watt) resistor can be installed inside a standard enclosing box for furnishing heat to help counteract the dampness found in practically all coal mines. If there is any danger of explosive gases the breaker should be enclosed in an explosion-proof case according to the specifications of the Bureau of Mines.

Other Sizes of Trolley Wires

Other sizes of trolley wires used in mines are No. 2/0 and No. 3/0, with occasional applications of No. 1/0 wire in short length cross entries, and No. 6/0 in very long entries where the normal No. 4/0 trolley would give excessive voltage drop. Fig. 5 shows the time-current curves for all the sizes mentioned (including the same data given in Fig. 3 for No. 4/0 wire).

(*Continued on page* 68)

The UPS and DOWNS of TRANSPORTATION*

By RALPH BUDD
Transportation Commissioner
Advisory Commission to the Council of National Defense

Mr. Budd, President of the Burlington Lines, is an expert in transportation problems who is giving his services to his country as Commissioner of Transportation, the Advisory Commission to the Council of National Defense. Under his capable direction the railroads are preparing to handle expeditiously the tremendous volume of traffic engendered by the country's defense efforts.

He was recently given the Washington Award for 1941, administered by a joint commission representing the five outstanding engineering societies of the country, which is presented in recognition of devoted, unselfish and pre-eminent service in promoting the happiness, well-being and comfort of humanity. Mr. Budd was the eighteenth recipient of this award, of whom the first was Herbert Hoover. Outstanding achievements in his career, leading to his present pre-eminent position include: Double tracking and multiple tracking of the old Panama Railroad; building of the Oregon Trunk Railroad up the Des Chutes Canyon in Oregon; making plans and beginning construction of the St. Paul Union Station; $25,000,000 relocation and electrification program of the Great Northern Railroad in the Cascade Mountains, Washington, including 7.79-mile Cascade Tunnel; inspection and report on the Russian railways; and development of the first diesel-powered streamline train (Burlington Zephyr) and track improvements to accommodate high-speed trains.

Mr. Budd attended the joint luncheon meeting of the Board of Directors, and Advisory Council of the Coal Division, American Mining Congress, and presented the timely discussion of transportation problems herewith given.

SINCE the present war broke out in Europe almost two years ago there has been a sharp increase in industrial activity and traffic in the United States. The immediate stimulus was the demand for materials and supplies for use in the war abroad. Soon that was augmented by buying to build up inventories here at home, and then by our preparedness program which was launched about a year ago. Transportation at once felt the effect of this sudden revival of business. Export tonnage other than grain handled through the Atlantic and Gulf ports reached a total almost equal to the peak of outbound traffic during the World War and has so continued. The reverse of the general trend has been the case with traffic in products of agriculture, exports of which diminished almost to the vanishing point when Norway and the Low Countries, and finally France, were overrun by German armies.

Freight Car Loadings an Index of Business Activity

The number of freight cars loaded is one of the best indices of business in this country, even though the railways now handle only about two-thirds of the total traffic. In 1939, due in part to the effect of the European war, carloadings increased 3,454,000 over 1938 to a total of 33,912,000. A further increase of 2,442,000 in 1940 brought the total to 36,354,000, or an average of almost 100,000 a day. In 1941 daily carloadings are estimated to average about 112,000. These averages include increases in some commodities and decreases in others; increases in some regions and decreases in others; high loadings during some weeks of the year, and relatively low loadings in other periods. The components are exceedingly numerous and varied, comprising as they do everything that is grown, mined, or manufactured, and moved in commerce. Coal contributes more tonnage than any other single commodity. It is so great that a substantial increase or decrease in coal shipments markedly deflects the graph of total freight carloadings. Full production followed by virtual suspension can result in such a wide swing as the following: The week of March 29, 1941, reported total carloadings, all commodities, of 792,125, or 26 percent above the corresponding week in 1940, but two weeks later the total was 679,808, or only 10 percent above 1940.

* Presented at the Annual Coal Show and Convention, American Mining Congress, Cincinnati, May 1.

Traffic Must be Directed to Maintain a Uniform Flow

Since the job of common carriers is to move goods and people from where they are to where they want to be, and to do so promptly in any desired quantity at any time, they should be ready always to take care of peak requirements. Nevertheless, in times like these it is very helpful to maintain as uniform a flow of traffic as possible, and unfortunate when anything interrupts such regular movement as has happened during the past month in your great industry. About 40 days coal supply had been built up in advance of April 1—some plants had less than that. Now the supply is short. During the next six months railroads, ships, barges, and trucks will have to take on the extra burden of hauling perhaps as much as thirty-five million tons of coal that was not mined during April, when thousands of coal cars and many locomotives were idle. More than 600,000 carloads will be piled on top of the seasonally rising volume, which means that a higher peak movement will be handled during the heavy traffic period than would have been necessary otherwise. Unless this and other interruptions reduce the industrial requirements for coal this year's bituminous production will be upwards of 500,000,000 tons, or about 12 percent above that of 1940. Output was slightly above 134,000,000 tons in the first quarter of 1941.

There Are Now Several Forms of Transport in Addition to Railroads

Unlike former periods of brisk business, there are now several forms of transport, each of which carries part of the whole load. As a consequence railway traffic and employment have declined greatly since 1929, although the total freight and passenger movement by all methods has increased substantially. The burden of moving freight divides about as follows: railways 65 percent, highways 8 percent; Great Lakes 13 percent, other inland waterways 3 percent, pipe lines 11 percent, and airways a fraction of 1 percent (but an important and increasing traffic). Of all passenger travel, 90 percent is in private automobiles; 5 percent on railways; about the same on buses, and one-half of 1 percent in airplanes. I suspect that coal operators will recognize a similarity between this situation and their own. Total power consumption of the country has increased, but coal consumption has not increased because coal supplies a lesser part of the total power requirements than formerly and shares the field with gas, oil, and water power.

In recent addresses I have called attention to the fact that for some years the transportation plant has been too large for the needs of the country. Also, that there is no way of determining just how great the surplus had become, for during the past decade while some forms of transports still have been in the expansion stage, the total volume of traffic has been smaller than what should be considered normal.

The year of greatest rail passenger travel was in 1920, when it amounted to approximately forty-seven billion passenger miles. The low point was sixteen and one-third billion in 1933. In 1940 it amounted to nearly twenty-four billion, or about half as much as in 1920. The high marks in railway freight were recorded in 1926 and 1929. In each of those years about fifty-three million carloads were handled. The low point was in 1932, when the volume was little more than half of 1929. In 1940 the railways handled thirty-six and one-third million carloads, or 68½ percent as much freight as they did in their best year. In general, transportation for National Defense is not unlike that for ordinary commerce; cars loaded with materials for peace and for war move in the same trains; the same car, truck or vessel may be loaded with war materials in one direction and peace materials in the other. The same pipe lines handle oil and gas for defense and for commercial uses. The similarity of service extends to the handling of passengers, whether it be by land or by air. The adaptability and elasticity of transportation facilities thus are in marked contrast with the special and often single purpose of a manufacturing plant. Also, transportation for defense is spread over the time consumed in the successive periods, first of construction, then of production, and in many instances, such as the building of cantonments and munition plants, the daily transportation load is greater during the period of construction than it is after their completion.

+ + +

Mr. Budd also spoke with keen interest on the equipment problems of the mining industry, with which he had become better acquainted as the result of an inspection tour through the exhibits at Music Hall. He showed a thorough understanding of the need for using special steels and other alloys in many cases where compactness and greater strength per unit of cross-section or of weight are required, these being similar to problems encountered in the building of railway equipment. He expressed a warm sympathy with the industry's need of priorities for certain vital equipment and replacement parts in the present emergency.

+ + +

Will the Railroads be Able to Provide Transport Now Necessary?

The question naturally arises whether the transport agencies of the country will be able to provide, without interruption or limitation, all of the services that may be currently required. It is a question which has been much discussed almost constantly for the past year. I have said on more than one occasion that transportation people must answer the question in a typically Yankee way by asking another, "how much traffic are we to handle, and when and where are we to move the freight?" I shall repeat again that it would seem rash to say that the railroads and other transportation agencies are equal to any and every conceivable task, or that they can handle all traffic that may be offered without knowing more of what its proportions may be. But if they can be kept informed a reasonable time in advance as to how much the volume will be increased, and by what kind of traffic, their performance of the past two years, together with new cars and locomotives and other improvements which have been made or are being made would give assurance of reliable and satisfactory service. Their ability in future to keep ahead of requirements must, of course, depend upon their knowing what traffic to prepare for, and also their being able to obtain new cars and locomotives and other essential materials as they will be needed. This is only a question of degree. The railways always are

large buyers of basic materials. In all of our important industrial activities there is an integration of the different functions which is somewhat like the synchronization of an assembly line in production. Take the case of steel—from the mining of ore to the fabrication of the finished product, each of the steps is geared to those before and after, and if the final output is to be stepped up there must be a corresponding increase in capacity all along the line. More ore will be mined, which will mean more rail transportation, more lake transportation, more furnaces, more rolling mills, and more factories.

Recent Improvements to Commercial Transportation

Commercial transportation facilities have been improved and enlarged during the past two years at a cost of about a billion and a half dollars as follows:

Railways:		
New cars	111,000	
New locomotives	825	
Total Expenditures for construction and equipment		$800,000,000
Trucks:		
New Units (trucks and trailers)	221,000	
Cost in dollars, including other facilities		250,000,000
Buses:		
New Units	36,000	
Cost in dollars, including other facilities		200,000,000
Pipe Lines:		
Miles of pipe	5,800	
Cost in dollars		50,000,000
Airplanes:		
Units—about 7,000 (including private planes)		
Cost in dollars		50,000,000
Waterways:		
Ships, barges, towboats, etc.		
Cost in dollars, about		100,000,000
TOTAL		$1,450,000,000

In addition vast sums have been spent by the Federal, state, and local governments for highways, waterways, and airports—probably $2,750,000,000 in all—while approximately $5,200,000,000 have been spent for private automobiles and trucks. Moreover, orders for railway cars and locomotives now in the hands of builders are greater than they have been on any May 1 since 1929. Unless work is delayed by shortages of material or labor 100,000 new freight cars will be delivered during 1941.

In order to inform the carrier managements of prospective service requirements the Advisory Commission to the Council of National Defense has made use of various studies, estimates, and forecasts of future traffic. Such studies will be continued and revised while the preparedness activity continues.

Estimates Have Recently Been Made of the Carload Freight Load to Meet This Emergency

Early this year the Bureau of Research and Statistics, Advisory Commission to the Council of National Defense, analyzed the National Defense Program, giving weight to its effect on individual purchasing power, and taking into account export materials and supplies, chiefly for Great Britain. This analysis was carefully examined by the Bureau of Railway Economics in terms of railroad transportation, and the results translated into the equivalent carloads of revenue freight. Carloadings, rather than tons, were used as the unit of railroad freight service because they are the most current of railroad statistics and are the best single measure for gauging equipment requirements. The result was that it was estimated that 3,426,628 more carloads would be moved in 1941 than in 1940. This would be an increase of 9.4 percent for the entire year.

These same two bureaus will revise the estimates from time to time based on later information, and such a revision is now in process. Advance figures indicate that the carloadings for 1941 will be substantially more than 40,000,000. Should they be 41,000,000, it would mean an increase of 12½ percent for the year. In that case the quarterly increases above 1940 would be:

First quarter, actual	14.8
Second quarter, estimated	12.9
Third quarter, estimated	12.5
Fourth quarter, estimated	10.1

The curve of total carloadings for the United States represents a combination of large increases in some commodities and regions, lesser increases in others, and decreases, large and small, in still others. Such a composite, since it consists of pluses and minuses, tends to level the extreme peaks and valleys, but even so it is a jagged curve, as you will observe from the chart. For example, the loss in coal loading in April was partially concurrent with a gain in ore loading by reason of early opening of navigation on the Great Lakes. By April 27 of this year 5,377,482 long tons of ore were loaded into boats at Upper Lake ports, against 221,718 up to the corresponding date of 1940, a gain of 5,155,764 tons. While in the mass figure this served to offset the loss in coal, the ore actually was handled with special equipment which is not used in coal traffic.

Seasonal Calls on the Railroads an Important Factor

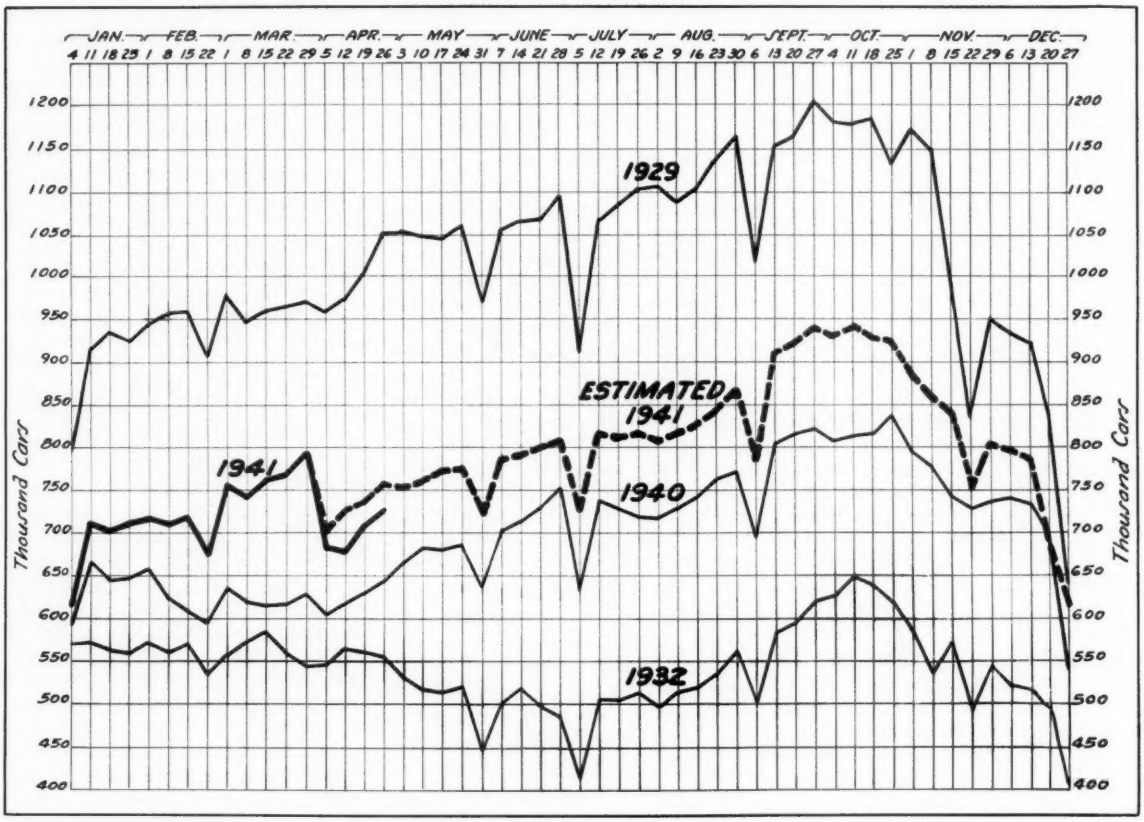
The ups and downs are well explained in a Review of Railway Operations prepared by Dr. Julius H. Parmelee, Director of the Bureau of Railway Economics, and published in the *Railway Age* of January 4, 1941, as follows:

"An outstanding feature of the railway freight traffic of 1940 was its spotty character, in so far as commodity and geographical distributions are concerned. Five of the eight principal commodity groups into which the Car Service Division classifies freight loadings showed substantial increases over 1939, while the other three showed small decreases.

"The following table shows the percentage increase or decrease in each of the eight commodity groups, 1940 compared with 1939, arranged in the order of greatest percentage increase to greatest percentage decrease:

Commodity group	Increase or decrease Cars (000)	Pct.
Ore	Inc. 530	Inc. 32.8
Coke	Inc. 135	Inc. 32.6
Forest products	Inc. 216	Inc. 13.6
Coal	Inc. 722	Inc. 11.9
Miscellaneous	Inc. 1,106	Inc. 8.0
Livestock	Dec. 9	Dec. 1.3
Merchandise, l.c.l.	Dec. 152	Dec. 1.9
Grain and products	Dec. 106	Dec. 5.5
Total	Inc. 2,442	Inc. 7.2

"The greatest relative increase took place in ore and coke loadings, which were nearly one-third greater than in 1939. Forest products and coal loadings also showed substantial increases. Miscellaneous loadings, which account for about two-fifths of the total traffic, increased 8.0 percent. Livestock and merchandice l.c.l. fell off slightly. Both of these groups feel



the effects of competition to a greater degree than do other commodity groups. Grain and products were affected by the export situation and showed the greatest relative decrease.

"Three of the seven regions (Car Service Division classification) reported carloading increases considerably above the national average, while the other four lagged appreciably behind the average. There is a correlation between this situation and the uneven distribution of increase in the loading of the several commodities, just described.

"The following table shows the percentage increase in carloadings, 1940 over 1939, in the seven regions, in the descending order of increase:

	Increase	
	Cars (000)	Pct.
Allegheny	905	13.4
Pocahontas	279	12.8
Northwest	519	10.8
Eastern	399	5.5
Southern	239	4.8
Central west	74	1.4
Southwest	27	1.1
United States	2,442	7.2

"This table indicates that the defense program had its initial effect on the industrial East (Allegheny region, including the Pittsburgh steel area), and next on the sections producing such raw materials as coal (Pocahontas region) and iron ore and lumber (northwest region).

"Other regions began to feel the quickening benefit of the program toward the end of 1940, as industrial pay rolls increased and consumer buying expanded, but these developments came too late in the year to exert an appreciable influence. Such an influence should be felt in 1941."

The plight of farmers and the decline in movement of products of agriculture which is contrary to the general upward trend is explained in a recent address by Agricultural Adjustment Administrator R. M. Evans, who said in part:

"In the last year and a half our export market for wheat has practically disappeared. War has blockaded our customers out and our wheat in. This is true all over the world. . . .

"Like Canada and the United States, Argentina faces a surplus problem—the result of a shrinking market. Most of her customers are either completely blockaded or so far away they can't get boats to carry the wheat. As a result Argentine wheat is lying down there without a market.

"With a whole crop of corn on hand, the Argentine Government gave farmers some 20 cents a bushel for last year's corn and then offered it back to the farmers for about 5 cents a bushel. But the farmers wouldn't even buy back their corn for a nickel. Now Argentina is burning corn as fuel in creameries, electric plants, and other establishments. Much of what is left is just stacked up outdoors, where it is rotting away."

Cotton surpluses are plaguing the growers of that staple in somewhat similar fashion. On the other hand, there exists, or is anticipated, a need of more meat, poultry, eggs, butter, tallow, and some vegetables.

These statements illustrate how greatly the demands for production and employment vary in different groups and occupations, and also in different regions, especially since farming and livestock raising are virtually the only pursuits in some parts of the

West. They also show how varied are the component parts of the nation's transportation load, for it reflects the complexity of the daily life of all the people.

Moving the Wheat Crop Must be Given Careful Planning

The problem of providing for an unforseeable amount of transportation is presented in the movement of the 1941 wheat crop, the harvest of which will begin in the next 30 days. It seems quite certain that the crop will be large and there does not appear to be sufficient elevator space to receive it all at once. For several months the Defense Commission has had the matter under consideration with the Department of Agriculture. Some new storage is being added and some grain is being moved to the seaboard, but no one is certain how much unused capacity there will be in the interior. Growers are being encouraged to provide storage on farms for the excess grain above what will be moved to elevators and mills. Dealing with so many farmers, and with such elusive things as the yields on individual farms, it is simply impossible to know in advance whether such farm storage will fully meet the situation. In the meantime, cars are being assembled for handling the crop, based on the best information available. More cars can be provided if it is found that more grain is to be moved than at first anticipated. If too many are assembled some of them will be moved away empty. This has happened in past years, but it is doubtful if so much uncertainty ever existed before. It is possible that with favorable weather, the total United States wheat crop may approach a billion bushels this year, so it is apparent that we are dealing with a problem of major proportions. An important thing from the national transportation point of view is that for grain, as for other shipments, an unloading place must be provided before cars are loaded so as to avoid tying up railroad equipment for storage purposes.

The Transportation Situation Can be Aided if Shippers Will Cooperate

The handling of transportation during this period of national preparedness will be greatly aided if all concerned will cooperate fully. The Advisory Commission to the Council of National Defense has endorsed the request of the railways that shippers:

1. Give advance notice of requirements, but do not order cars placed for loading until commodities are ready to load.

2. Unload cars promptly on arrival and notify railroad when empty car is available.

3. Load cars to maximum journal-carrying capacity or full visible capacity, whichever governs.

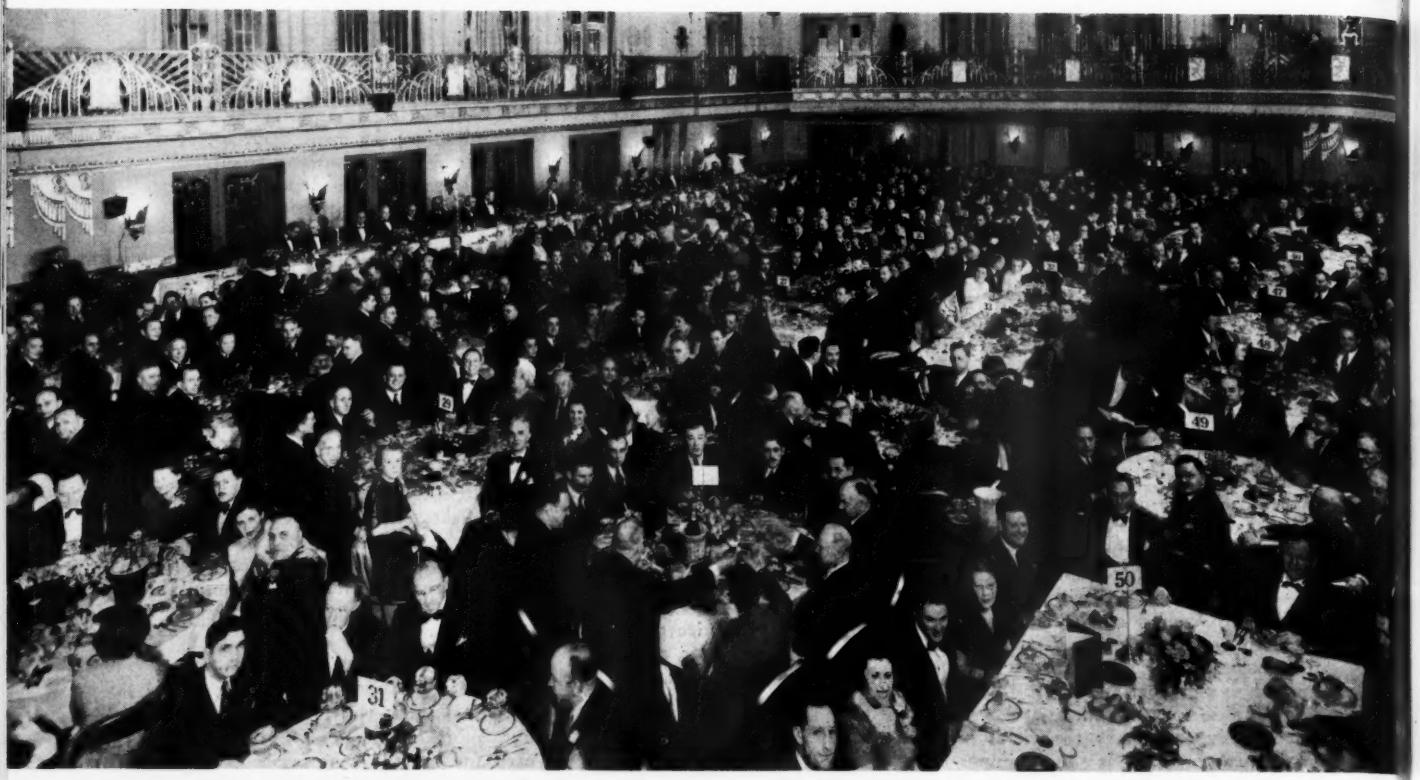
4. Remove all dunnage, blocking, and rubbish from cars after unloading to permit immediate re-use and eliminate necessity of delay to cars for reconditioning.

5. In industries where 5-day work week is in effect, some plan should be worked out to provide at least 6-day basis for loading and unloading cars.

Transportation is an integral part of production; its need may appear many times in the transition from raw material to the finished product, and any disturbance of the orderly rhythm affects transportation adversely, as it does production itself. Through the processes of competition and private initiative, a substantial volume of our essential materials have found the most efficient and economical methods, including the correlated use of one or more forms of transportation; it is very important that there should be no arbitrary breakup of this arrangement.

Addressing the members of the Great Lakes Regional Advisory Board on March 26, 1941, Capt. E. C. R. Lasher, who has charge of transportation for the Quartermaster General, closed with a statement which I cannot improve upon:

"Let me leave you, as shippers, with a word of caution. Do not become hysterical about this job. It is big—but approach it calmly. There is need for speed, but remember everything cannot be shipped at the same time—let the priorities of production take care of that. There are many things to be done, but keep your actions orderly, and, above all, let everyone bend his every effort toward keeping transportation under control. Bear these things in mind, heed them, and we will move anything, any time, anywhere!"



Annual Banquet Thursday evening fills Hall of Mirrors

Above: Attentive audiences listen to discussions of operating problems

1941 Coal Show

North Hall Exhibit Floor

• *Attendance of 4,133, Despite Wage Uncertainties, Again Attests Value of Annual Coal Show.*

Voted Outstanding Success

WHEN the Eighteenth Annual Coal Show and Convention of the American Mining Congress drew to a close on Friday noon, May 2, coal-mine operators and officials, manufacturers' representatives and visitors expressed the conviction that the five days of activities at Music Hall in Cincinnati and at the Hotel Netherland Plaza made up one of the most successful coal-mining conventions ever staged.

On Sunday, April 27, the day before the convention opened, the registration totaled over 500, and on succeeding days these totals mounted until over 4,100 registrations had been made by Friday noon. The exposition floors and meeting halls were thronged each day. The exhibits in the north and south halls, in the lobby and on the convention floor were complete in the variety of mining machinery and equipment shown, and, while attendance was below that of last year, the enthusiasm and interest of exhibitors and coal operators alike contributed to the great success of the meeting. Before the meeting some uncertainty had been expressed as to the total attendance this year, because of the wage scale negotiations under way in the Appalachian fields, but although the prospect of an early settlement, together with actual resumption of work on Thursday of convention week, did prevent attendance of many executives and operating officials, the large number present in spite of such adverse conditions was most gratifying.

The total registration up to Friday noon was 2,046 coal operators, 1,760 manufacturers' representatives, and 327 ladies and guests. One prominent industrialist who attended expressed the thought of others when he said: "This show has year by year been the greatest single factor in the improvement in efficiency and modernization in the coal mines of this country. Were it not for this yearly opportunity for coal-mining men to meet and discuss their problems, see what other mines are doing and what the manufacturers are preparing for the industry, our coal-mining industry could not have made the tremendous progress of the past decade and more." Preparations are already under way for the convention at the same place and approximately at the same time next year.

In large measure, the success of the convention and exposition was due to the hard work and enthusiasm of the committee chairmen and committee members. George B. Harrington, president, Chicago, Wilmington & Franklin Coal Company, as national chairman of the Program Committee, with a roster of operating men working with him on the State and Regional Program Committees, had arranged for speakers and subjects of great interest to coal mining men today. Arthur S. Knoizen, vice president, Joy Manufacturing Company, and chairman of the Manufacturers Division, with his co-members, had likewise taken a prominent part in the arrangements made, as had also R. L. Ireland, Jr., president of the Hanna Coal Company, as chairman of the Coal Division, and the division members. The chairmen and committee members, who labored to such a worthy end in making this meeting outstanding, are due a vote of thanks from the industry for their major share in furthering the cause of better and more efficient mining.

In addition to those just enumerated, special thanks are due to J. B. Morrow, president, Pittsburgh Coal Company, chairman, and his Attendance Committee for the excellent turnout this year under adverse conditions; to Arthur C. Green, vice president, Goodman Manufacturing Company, chairman of the Publicity Committee, and the other hard-working members of that com-

mittee, for the sustained and high type of publicity which aided in drawing such a representative crowd to the convention; to the Welcoming Committee, with B. H. Schull, executive vice president, Binkley Mining Company, as chairman, who took turns in greeting delegates and providing a friendly atmosphere for newcomers; to the Floor Committee, D. H. Pape, president, Sheridan-Wyoming Coal Company, chairman, for their aid in the smooth working of the meetings and guidance of the discussions; to the Committee on Miners' Exhibit, Jerome C. White, Monroe Coal Mining Company, chairman, for procuring for exhibit a large number of gadgets and mechanical improvements at the "Miners' Exhibit" booth, illustrating the inventiveness and technical ability of coal company personnel; and, finally, particular thanks are extended to the Entertainment Committee, with J. H. Fulford, general manager of sales, Jeffrey Manufacturing Company as chairman, for the splendid series of lively, amusing and worth while features of the entertainments, each better than the last and culminating in an hour-long show at the annual banquet on Thursday night, that was stamped "super" by all who saw it.

Two operating sessions were held each day Monday to Thursday, April 28 to May 1, inclusive, with two additional sessions on Tuesday afternoon and Wednesday afternoon devoted to the problems of the coal stripping industry.

Delegates Greeted by Mining Congress Officials

On Monday morning, April 28, at 10:15 the sessions were opened in the main meeting room at Music Hall by Julian D. Conover, Secretary of the American Mining Congress, speaking to an overflow crowd. The Secretary stressed the importance of the convention to the coal mining industry and the country in general at this time. Our whole defense effort is dependent on an adequate supply of fuel. He expressed the keynote of the meeting as follows:

"We are opening today our Eighteenth Annual Coal Convention and Exposition. I need not say that these are critical days, and we realize more than we ever did before that we have come together for a serious purpose.

"All of us here today know that the mining of coal is basic to the all-out defense effort in which our country is engaged. We know that a continued supply of coal is absolutely necessary—it is one thing that is basic and indispensable—both as a raw material in the steel and chemical industries and as the principal source of power for production and transportation both of armaments and of the necessities of daily life.

"We know that the coal industry will be called upon to perform a vital part in the defense program, and we must consider this week how we may best prepare ourselves to meet that call.

"For the coming months we foresee many new and difficult problems of production. 'Business as usual' will be out the window. The building of an adequate defense must be given the right-of-way, and must be crowded with all possible speed. The peak of this effort is still to come and the assembling here of the nation's mine operators and mine equipment manufacturers evidences their determination to prepare our mines for whatever emergencies lie ahead.

"Statements have been made in high quarters, and in the coal industry itself, that there need be no concern over an ample supply of coal, that our mines are prepared to meet whatever demands may be made upon them. This is no doubt true as to potential or theoretical capacity, but it is actually true only if certain extremely necessary conditions are met. If we are to realize that capacity we must be able to retain a sufficient number of the skilled, highly trained men required to operate the modern coal mine of today; we must be assured an adequate supply of railroad cars to avoid a transportation bottleneck such as developed in 1918, and particularly—and this is a matter which should receive special emphasis at this time—the operators must be able to obtain, and the manufacturers must be able to furnish, the replacement parts needed to keep our present mining machinery in continuous operation, and the new equipment required for increased and efficient production. . . .

"Already we find the manufacturers faced with serious difficulties in securing certain of the key materials, such as nickel and other alloy steels, non-ferrous metals, etc., which are needed to give working parts the strength required for severe service underground. Substitution of inferior materials necessarily means increased breakdowns and loss of production. The failure of a key machine such as a fan or a pump may shut down an entire mine for an indefinite period unless the necessary replacement parts can be obtained promptly.

"While recognizing the absolute priority that must be accorded defense requirements for these materials, we must not overlook the fact that COAL IS DEFENSE, and that both coal and metal mining are, in a very real sense, defense industries and should receive consideration accordingly. We must give our best thought to these problems which are of such critical importance to both mine operator and manufacturer. We must cooperate with the defense authorities to the fullest, both from the standpoint of our industry and the standpoint of the nation.

"Fortunately the defense organization, as those of you who have been in contact with it well know, contains many men of broad industrial background and understanding as well as deep patriotism, with whom the merits of this problem may be considered frankly and openly and a solution worked out if at all possible. We have laid it before them in considerable detail, and we welcome your help in giving them the fullest possible information."

The next speaker was George B. Harrington who, as national chairman of the Program Committee, welcomed the delegates in the following words:

"We are opening the Eighteenth Annual Coal Convention and Exposition of the American Mining Congress—the Annual Coal Show, now securely entitled to its reputation of being one of the most comprehensive and worth while exhibitions of equipment and of production methods, and most truly representative gatherings of the leaders who plan, equip and operate the country's coal mines—of any similar convention, for any industry, anywhere.

"The chairman of the Program Committee also, as well as your Secretary, has the privilege of extending a welcome to you delegates, and to our manufacturing associates. This I do, most cordially, and with the greatest of pleasure.

"Your committee chairman rates only a very small share, however, of the credit for our fine program, and long before coming to Cincinnati he has been generously compensated by the privilege of working with your tireless Secretary and his exceptionally efficient staff, and also by association with the well qualified gentlemen who make up your nation-wide Program Committee. I have had many experiences over the years with similar full time and volunteer part-time industry workers and committees, but I have never encountered any comparable group or activity that has won more of my admiration and respect. I wish to thank, for myself and if I may also for all of you, Mr. Conover and the staff of the Coal Division of the American Mining Congress, and all the members of this year's Program Committee, and also Mr. Arthur Knoizen and the Manufacturers Division, for the splendid cooperation which makes this year's show and

Sessions on Strip Mining draw many operators

program the success we are confident it will be.

"It would be trite to say that this is an extraordinarily complex year and time in which we find ourselves, and probably it would serve little purpose for me to attempt to point out features of world or national emergency which make our tasks of coal production more than ever vitally essential. Always remember that 'Coal is Defense'—that is a splendid motto. It says *so much*, so briefly. But there are, additionally, rapidly growing problems in other departments of our industry which do not come within the practical limits of discussion at these Cincinnati meetings. Notably, such puzzlers as the present double-barrelled price control, and tangled labor relationships, are most acute at this very time and may prevent attendance here this week of many who otherwise would come and whom we will greatly miss.

"However, we have made to date, and certainly this is my own considered opinion, magnificent progress in improving and modernizing the dependability and safety of our mining operations. The American Mining Congress has afforded us very valuable opportunity to get to know, to trust and to cooperate with each other, and I believe that on the great branches of our work that the Coal Show conventions are able to study, we are a *united* and *forward-looking* industry. May the example of our unity and accomplishments here in this city serve to help the coal industry to become an even more completely integrated and useful pillar of strength in the national defense."

The chairman of the Manufacturers' Division, Arthur S. Knoizen, was then introduced and discussed briefly the cooperation necessary between coal operators and manufacturers of mining equipment and supplies in these strenuous times, as follows:

"We sincerely hope that you will enjoy your visit and gain profitable knowledge of the new equipment that is now available for the mining of coal. This meeting affords an opportunity for the mining personnel and the manufacturers to get together and discuss their mutual problems, and we hope that the mining industry as a whole will take full advantage of the great opportunity that this convention offers.

"Our entire organizations, both mechanical and mining, will be at the operators' command at all times and the only way in which the coal industry can get its required equipment, such as new developments and improvements in machinery, is through the unlimited cooperation of the mining personnel and the manufacturers. . . .

"The executives of this nation's mining industry can depend upon the manufacturers' complete support in keeping their equipment running and their deliveries of regular machines coming out as nearly to schedule as possible—and I feel that I can say this for the entire manufacturing industry—just as long as it is possible for the manufacturer to obtain raw materials. But only through the close cooperation of mining personnel and manufacturer are we going to be in a position to develop and deliver the equipment that you will need for the mining of coal as economically and in the increased quantities that will be required by the country in these difficult times.

"With the possible limited labor supply that is now very obvious in many sections of the country, the demand for new equipment, improvements and service parts is going to be greater than at any time in our history.

"The manufacturers are laying plans far in advance to take care of your requirements, limited only by defense demands which may be imposed during this coming year. Our raw materials are getting more difficult to obtain. They are tightening up on some very strategic minerals that we need and are going to need in greater quantities to give you the service on machines and parts that you are going to require.

"It would be well for considerable thought to be given to priorities on equipment used in the production of coal. This may best be accomplished by the cooperation of the coal operator and manufacturer working as a unit in conjunction with or through the American Mining Congress, because this organization has been set up for this service, and I believe this is the only way we will solve this problem which is going to confront us in a much more aggravated form than it does today. The operators cannot fully appreciate the difficulties they may be confronted with in the very near future in getting materials and supplies, either in new machines or new developments, and an organization of this kind set up between manufacturers and coal operators should be able to perform and accomplish things that are impossible by individual action."

Mining Congress Journal exhibit on Convention Floor

With Moroni Heiner, president, Utah Fuel Company, as session chairman, presentation was then made of the program papers for the morning, on "Coal and National Defense," by L. W. Householder, and "Certain Aspects of Coal Mine Safety," by Eugene McAuliffe.

On the succeeding days programs were held as scheduled, each session being attended by an interested and widely representative group of operators and delegates. Papers were presented on various phases of face operations and mechanization underground, as well as on economic affairs, mine safety, mechanical and electrical maintenance underground, lubrication, power distribution, and cleaning and preparation of coal. On Tuesday afternoon and Wednesday afternoon, two additional sessions were devoted to discussion of problems applying particularly to coal strip mining. These papers covered such subjects as exploration for coal stripping, overburden preparation, planning and working smaller strip mine operations, hydraulic application to coal stripping, open-pit coal mine haulage, and strip mine maintenance. Informed authorities discussed each subject. Digests of all papers presented are given on pages 44 to 54.

"Information—We Hope"

A new and unusual feature of the program this year was the inclusion of a period devoted to questions on operating subjects, answered by a panel of experts on the platform. This was held on Thursday morning. On the platform was George B. Harrington as moderator, assisted by Harry A. Treadwell as assistant moderator, and with C. W. Connor, R. H. Morris, L. E. Young, and Raymond Mancha making up the panel to handle the questions submitted. The purpose of this new feature was not to stump the experts, as on a radio show, but to bring out for discussion pertinent and perplexing problems which might not otherwise have an opportunity for an airing at these meetings. Certain questions were prepared beforehand and had been considered by the panel before discussion was started. Other questions were submitted from the floor. The medium for the interchange of operating ideas thus presented, proved to be a very valuable contribution to the convention. The consensus of opinion was that it had been a most successful experiment and that at succeeding conventions, additional time and scope should be allotted to this manner of presentation and

Board of Directors and Advisory Council, Coal Division, hear Ralph Budd

discussion of the many operating problems faced by coal mining men today.

Session Chairmen

Distinguished mining men presided at each session, and with the cooperation and help of the Floor Committee, conducted the programs with smoothness and dispatch and maintained discussion in a well-ordered manner.

The men who thus generously contributed their services to the success of the meeting were: Moroni Heiner, president, Utah Fuel Company; John T. Sydnor, vice president, West Virginia Coal & Coke Corp.; S. M. Cassidy, manager, Weirton Coal Company; W. J. Borries, general manager, Dawson Daylight Coal Company; Hugh B. Lee, vice president and general manager, Maumee Collieries Company; D. H. Pape, president, Sheridan-Wyoming Coal Company; H. B. Husband, division manager, Consolidation Coal Company; William L. Burt, vice president, The Jefferson Company; and L. E. Young, consulting engineer of Pittsburgh.

Ralph Budd Speaks at Joint Luncheon Meeting

On Thursday, May 1, at 12.15 p. m., was held a joint luncheon meeting of the National Board of Directors and the Advisory Council of the Coal Division, at which were present more than 100 members and guests to hear an exceptionally able speaker and one prominent in the councils of the nation. The guest speaker was Mr. Ralph Budd, president of the Burlington Lines and Commissioner of Transportation in the National Defense Advisory Council. In the unavoidable absence of Howard I. Young, President of the American Mining Congress, Mr. Budd was introduced by R. W. Gillispie, president, Jeffrey Manufacturing Company, who has known him for many years. Mr. Budd's address on "The Ups and Downs of Transportation" is carried in full in this issue of the Journal. By means of charts and statistics, he showed the magnitude of the transportation problems involved in preparing this country for defense. He said that every effort must be made to smooth out the peaks of freight volume, such as those occasioned by the movement of grain crops and coal. In this latter regard the coal industry and coal consumers can be of help by moving coal as much as possible in the so-called slack summer months instead of in the fall, when such movement normally reaches a peak.

Miners' Exhibit

Special space was provided at the exposition for a showing of devices and ideas developed at the coal mines. The display of gadgets at the Miners' Exhibit was evidence that the men at the mines use their brains as well as their muscles, and are thinking along the lines of safety and efficiency. Car stops, drill plugs, trolley nips, machine guards, and automatic switches demonstrated ways to overcome hazards of mechanical operation, and there was a varied list of other devices designed to eliminate delays in operation and repair.

As a mark of appreciation, the American Mining Congress presented each exhibitor with a complimentary copy of the 1941 Year Book and a year's subscription to the MINING CONGRESS JOURNAL; and in addition, ten displays were selected by the Miners' Exhibit Committee for a spe-

Miners display new devices and gadgets

cial $10 award. It was rather difficult for the committee to judge among the displays, as all showed a high degree of ingenuity in their design, and the awards were made to those judged to have the widest scope of application.

Following is a list of the prize winners; descriptions and photographs will be published in a later issue of the Journal:

Cutter Chain Safety Device & Sheave Bracket

JAMES BURKETT, *Electrician*
Clearfield Bituminous Coal Corp.

Automatic Incline Limit Switch

ROBERT W. FORTNER, *Gen. Mine Foreman*
Benedict Coal Corp.

Automatic Adjusting Walkway for Loading Boom Used as Picking Table

E. L. SALYERS, *Master Mechanic*
Wise Coal & Coke Corp.

Ball Nip Catcher

SAVAGE ADKINS, *Chief Electrician*
Puritan Coal Corp.

Sectional Steel Mine Tie

JAMES C. PURDON
ARTHUR J. DUKES
Stonebridge Coal Co.

Fused Drill Plug

JOHN FUSHKO, *Mechanic*
Pursglove Coal Mining Co.

Guard Rail for Panel Entry and Room Track

WM. GUINEY, *Mine Manager*
Bell & Zoller Coal & Mining Co.

Track-Switch Position Indicator

J. G. POLLOCK, *Outside Foreman*
Heisley Coal Co.

Car Stop Carrier for Rope Haulage

PAUL E. RHEA
Rochester & Pittsburgh Coal Co.

Cable Cutter

HOWARD POLAND, *Section Foreman*
Pursglove Coal Mining Co.

Manufacturers Division Meets; Officers Elected

On Monday morning, April 28, at 11 o'clock, the Manufacturers Division of the American Mining Congress met in Music Hall with A. S. Knoizen, chairman of the Division, presiding. First in the order of business was a report by Secretary Conover on the work of the Congress and the Manufacturers division, including particular reference to the efforts being made by the organization in Washington to secure full consideration of the needs of mining equipment manufacturers for metals and alloys, an increasing number of which are being placed under priority controls. These metals are obviously needed if the mining industry is to meet all demands which may be made upon it in the coming months. An animated discussion of this subject followed the report.

E. J. BURNELL
Newly elected Chairman, Manufacturers Division

In honor of two of the founders and active supporters of the Coal Show for the past 18 years, the members rose for silent tribute to the memory of J. T. Ryan and J. C. Wilson, both of whom have passed on in the last year.

Acting upon the report of the Nominating committee, the following were elected members of the Board of Governors to fill vacancies existing at this time: M. R. Budd, Hercules Powder Company; H. H. Bullen, American Steel and Wire Company; E. J. Burnell, Link-Belt Company; R. L. Cox, The Jeffrey Manufacturing Company; William E. Goodman, Goodman Manufacturing Company; A. L. Johnston, Electric Railway Equipment Company; and J. L. McDowell, American Car & Foundry Company. After these men were confirmed in their new positions, the meeting adjourned.

The Board of Governors of the Manufacturers Division then met briefly to elect officers for the Division. Elected to serve one year each were: Chairman, E. J. Burnell, vice president, Link-Belt Company; first vice chairman, John W. Haddock, vice president, Sullivan Machinery Company; second vice chairman, George E. Stringfellow, vice president, Thomas A. Edison, Inc.; third vice chairman, H. V. Brown, general manager, Brown-Fayro Company. The meeting then adjourned at 12 o'clock.

EXPOSITION

All aisles of the north and south halls, the main lobby and the convention floor at Music Hall were filled with the displays of 141 companies, exhibiting all varieties of equipment and supplies from the largest heavy-duty machines such as coal cutters, loaders, conveyors, transfer cars, compressors, locomotives, fans, drilling equipment, and mine cars, to all manner of small parts, replacements and supplies for the coal mining industry. The booths were, without exception, well planned and attractive, and active interest was displayed by the operators in studying the manufacturers' products and in obtaining detailed information on their functions and attributes. The Show was complete in

Exhibits in Main Lobby are attractive

Left and below: Booths and displays in North Hall are attractively arranged and have much to interest the operators

Left: South Hall exhibits include heavy machinery in operation, and a wide variety of other mining equipment and supplies

every detail, presenting to all a well-rounded picture of the intricate and highly mechanized nature of present-day coal mining. No longer is coal mining principally a matter of a shovel, a keg of powder and a strong back, and these displays illustrated vividly the extent to which it has become a mechanized industry. Preparation and screen equipment was on display, as well as car dumps and other items for the handling and preparation of coal on the outside. Replacement parts, blasting accessories, welding supplies, bearings, lubricants and a host of others, such as items for the shop completed the displays.

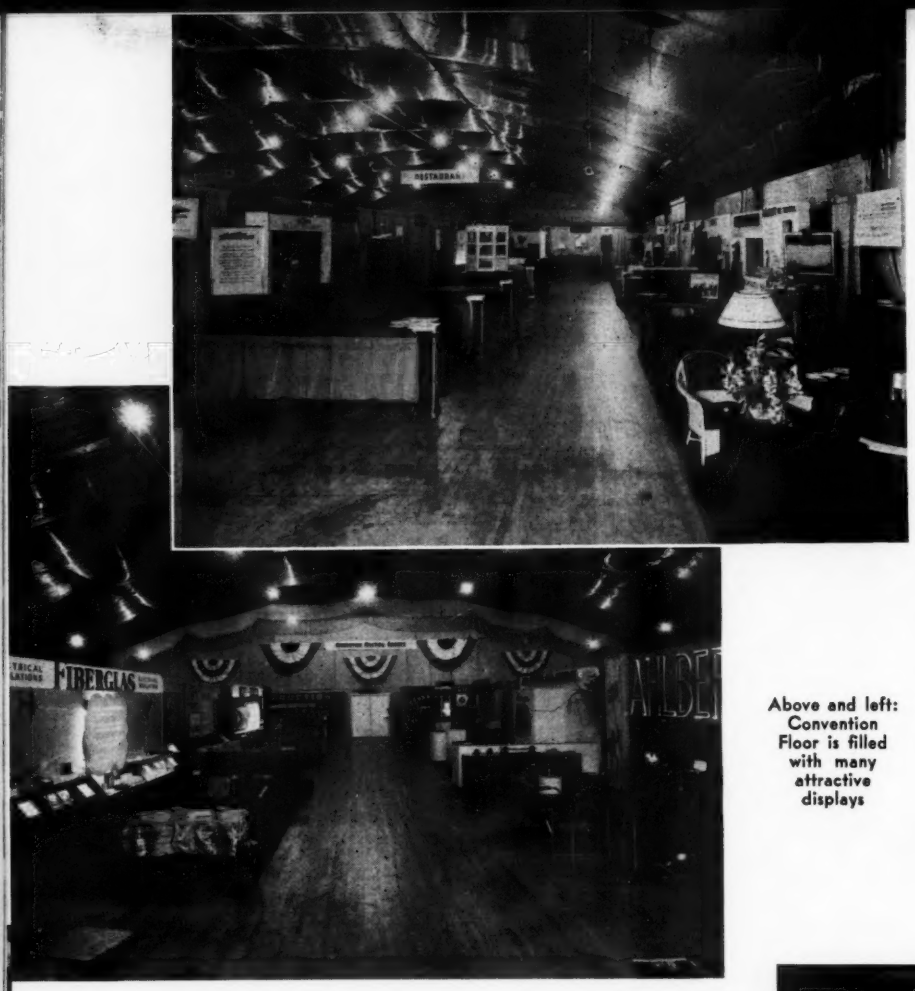
Descriptions of these exhibits were carried in the April issue of the Journal and will therefore not be repeated here.

ENTERTAINMENT

For the evening hours, J. H. Fulford, general manager of sales, Jeffrey Manufacturing Company, as chairman of the Entertainment Committee, and his staff of willing co-workers on the committee, had provided a series of features that were most popular, and enthusiastically received.

On Monday evening the King Coal Club in the Pavillon Caprice of the Netherland Plaza was crowded to capacity for dinner service, following which two floor shows were held. Dell O'Dell, with her line of patter and tricks, was mistress of ceremonies and kept the shows moving along in a humorous and entertaining mood. There were singing and dancing turns,

THE JOHNSON-MARCH CORP.
LINK-BELT
FOR EVERY CONVEYOR JOB THERE'S A LINK-BELT
TIMKEN
BEARINGS
ATLAS
KOPPERS
SULLIVAN
UNITS OF UNION CARBIDE AND CARBON CORPORATION



Above and left: Convention Floor is filled with many attractive displays

including the Janette Hackett Revue, the singing Texans and other well received acts.

On Tuesday night dinner service was held at the usual hour in the King Coal Club with another fast-moving floor show. This was "Fight Night" and at 10 o'clock the jovial crowd moved over to the Hall of Mirrors, where a boxing ring had been erected and a series of bouts was held, between Golden Gloves fighters representing mining companies in various parts of the country. Eight bouts were held, in each of which the boys had been carefully matched for weight and ability, and every one of the contestants was in there fighting every minute. A ninth bout had been arranged, but at the last minute the doctor barred one of the boys from fighting, and his opponent was given the winner's prize by default.

Six of these fights were for three rounds of two minutes each, and two of them went for five two-minute rounds. All classes from bantamweight to heavyweight were represented. Marion Klingensmith, who was acclaimed champion of champions at the fights last year, was back again this year fighting Charles Sackett, of Belleville, Ill. This fight went for five rounds and judging by the applause and enthusiasm of the on-lookers, it was by far the outstanding slug-fest of the evening. For his furious fight Marion Klingensmith was again acclaimed champion of champions, receiving the special award of a radio. However, his opponent gave such a good account of himself that the applause for his performance drew special recognition; the American Mining Congress with the very evident consent and approval of all present, awarded this loser a gold wrist watch, such as was given to the winner of each bout.

Every contestant was presented with a flannel robe, silk boxing trunks and shoes, and each winner was presented with a 15-jewel Gruen gold wrist watch.

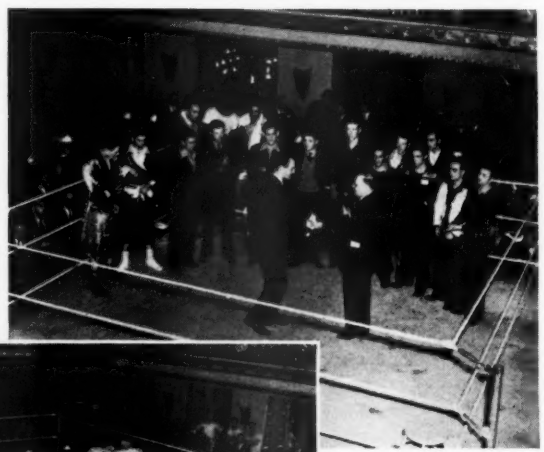
A list of the fighters, showing the coal companies they represented, and the winners are as follows:

FLYWEIGHT

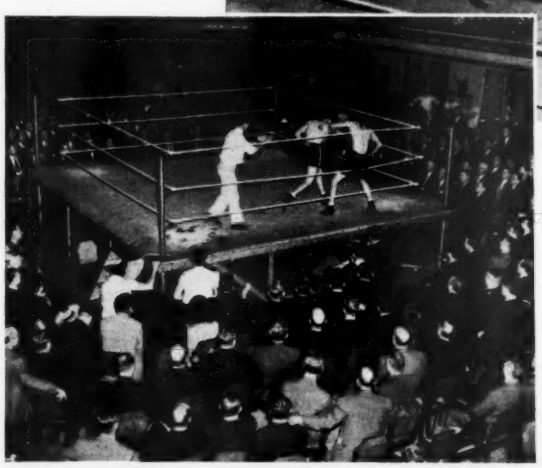
Johnny Osburne, Ameagle, W. Va., representing Peabody Coal Co.; age 21; weight 112 lbs.

Clarence Bradley, Murphysboro, Ill., representing Consolidated Coal Co.; age 21; weight 112 lbs.

Winner: Bradley, by decision.



Right: "Fight Night." Champ of champs is awarded a radio



Left: Fast action featured the amateur fights

BANTAMWEIGHT

Billy King, Highcoal, W. Va., representing Anchor Coal Co.; age 18; weight 118 lbs.
William Bradley, Murphysboro, Ill., representing Indiana Coal Co.; age 17; weight 126 lbs.
Winner: King, by decision.

FEATHERWEIGHT

Paul Messina, Birmingham, Ala., representing Tennessee Coal, Iron and Railroad Co.; age 21; weight 126 lbs.
Jos. Oliverio, Rivesville, W. Va., representing Consolidation Coal Co.; age 22; weight 125½ lbs.
Winner: Oliverio, by decision.

LIGHTWEIGHT

Joe Giangrosso, Birmingham, Ala., representing Tennessee Coal, Iron and Railroad Co.; age 22; weight 135 lbs.
Johnnie Roach, St. Louis, Mo., representing Chicago, Wilmington and Franklin Coal Co.; age 22; weight 135 lbs.
Winner: Roach, by decision.

LIGHTWEIGHT

Moon Mullins, War, W. Va., representing Carter Coal Co.; age 20; weight 130 lbs.
Paul Shields, Mt. Vernon, Ill., representing Peabody Coal Co.; age 24; weight 126 lbs.
Winner: Mullins, by decision.

WELTERWEIGHT

Les Reinoehl, Brazil, Ind., representing Rio Grande Coal Co.; age 21; weight 147 lbs.
John Rosen, Powhatan Point, Ohio, representing Powhatan Mining Co.; age 24; weight 140 lbs.
Winner: Reinoehl, by decision.

MIDDLEWEIGHT

Marion Klingensmith, Brownsville, Pa., representing H. C. Frick Coke Co.; age 21; weight 158 lbs.
Charley Sackett, Belleville, Ill., representing Bell & Zoller Coal and Mining Co.; age 21; weight 160 lbs.
Winner: Klingensmith, by decision.

LIGHT HEAVYWEIGHT

Foster Pompei, Powhatan Point, Ohio, representing Powhatan Mining Co.; age 22; weight 162 lbs.
Charley Kowaleski, Switchback, W. Va., representing Pocahontas Fuel Co.; age 21; weight 165 lbs.
Winner: Kowaleski, by default.

HEAVYWEIGHT

James Neale, Highcoal, W. Va., representing Anchor Coal Co.; age 25; weight 187 lbs.
Oshibe Smallwood, Mt. Vernon, Ill., representing Old Ben Coal Corp.; age 26; weight 178 lbs.
Winner: Neale, by decision.

Van B. Stith, superintendent of mines, Anchor Coal Company, was the very capable announcer of these fights and ran them off with workmanlike precision. Following the fights the second floor show was staged in the King Coal Club.

On Wednesday night a miners jamboree was held in the King Coal Club, with two completely new and sparkling floor shows during the evening.

The annual banquet on Thursday evening in the Hall of Mirrors was again the biggest get-together of the week. The hall and balcony were crowded to overflowing. The banquet is traditionally a "speechless" occasion, and at the conclusion of the delicious meal, George B. Harrington, National Chairman, with brief, humorous and pertinent remarks introduced the toastmaster, L. Ebersole Gaines, president, New River Company and president of the West Virginia Coal Association, who had come directly to the meeting from the wage negotiations then in progress in the Appalachian field. Mr. Gaines provided a delightful, light touch in his few remarks which hit the spot; he then introduced Mayor James G. Stewart, of Cincinnati, who made a short and rousing talk, expressing his appreciation for the opportunity to be present and the pleasure of the city at having the Mining Congress Convention. Mr. Gaines then presented those sitting at the head table with a geniality and brevity which met with universal approval. Space was then cleared at one end of the hall for a stellar entertainment program, headlined by the radio favorite Lee Sims and his wife Ilomay Bailey in "Piano Moods and Songs." These well-known entertainers with an intimate style all their own were enthusiastically received, particularly when it became known that they were celebrating their tenth wedding anniversary. They had been brought back by command of those who heard them and liked them so well on a previous convention program.

At the conclusion of these festivities, the entertainment and merrymaking was resumed in the King Coal Club, bringing to a close a well-prepared and lively series of shows, acclaimed by all who saw them.

Bridge luncheon for the ladies is held in garden-like atmosphere

LADIES' ENTERTAINMENT

For the ladies, the entertainment for the week was varied. On Monday noon a welcoming luncheon was held in the Restaurant Continentale at 12:15 p. m. The tables were decorated with flowers and spring-like favors of colored sachets. After luncheon a sight-seeing tour was taken, ending in a back-stage visit to one of the large department stores of the city.

On Tuesday afternoon a trip was made to the famed Cincinnati Zoo—a personally conducted tour by Zoo officials. Here, by special dispensation of the Zoo management, they were entertained with a floor show, starring Janie and Billy, two young chimpanzees who skated, boxed and danced the hula; they also rode tricycles and interspersed their antics with an effective "razzberry." The ladies were also treated to a view of Susie, the only trained gorilla in captivity, who came to this country on the Graf Zeppelin. Susie displayed her fine table manners as she ate a meal of spinach and other foods with a spoon and fork, and drank her milk from a glass, using her napkin in the approved, polite fashion. At times she had to be admonished by her trainer, but on the whole she was a very well-behaved lady.

A bridge luncheon was held on Wednesday noon in the Hall of Mirrors. The room was transformed into a garden for this occasion, with lilacs and evergreens forming a hedge. The tables were decorated with baskets of violets, and banks of these colorful flowers made a border at the foot of the lilacs. Thirteen tables of bridge participated, following the luncheon.

Thursday was a day without formal entertainment, to allow time for shopping, visiting or touring, followed by a rest in preparation for the banquet in the evening.

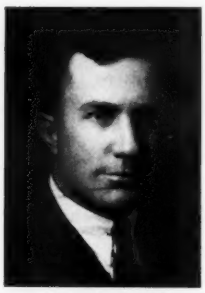
Operating Progress, Coal Preparation, Safety and Economic Questions Confronting the Industry Discussed by Outstanding Authorities

A condensation of each of the scheduled papers presented during the four-day program follows, classified into the various branches of operations. These papers will be printed in full, with all pertinent discussion of them made from the convention floor, in the Coal Mine Modernization Yearbook—1941, to be published later this year.

Face Operations and Mechanical Mining

REQUIREMENTS FOR SUCCESSFUL DUCKBILL MECHANICAL LOADING, by S. W. Blakslee, General Manager, Powhatan Mining Co.

In the fall of 1938 a study was made of the Powhatan mine for the purpose of ascertaining whether or not the mine could be efficiently mechanized and, if so, what type of equipment would be recommended for the mining operation. The investigation disclosed the following salient features:



S. W. BLAKSLEE

1st—The mine had a preparation plant and the ⅜ x 6-in. coal was prepared for shipment in a sand flotation cone.

2nd—Loaded mine cars average 2.6 net tons when loaded to water-level capacity.

3rd—Rooms were projected 220 ft. long, 24 ft. wide, and turned on 32-ft. centers, but the average distance rooms were advanced was approximately 180 ft. A single-shift room rarely attained a depth of 160 ft. Only double-shifted rooms ever reached their projected distances. Pillars were not drawn.

4th—Draw slate fell infrequently as the coal was blasted. Thin draw slate was shot in room roadways and supported on props in gobs. Thick slate was not taken down in roadways unless it had a tendency to fall with the coal. Otherwise it was supported indefinitely on three-piece sets of timber placed on 42-in. centers. The collar or cross-bar was a 3-in. plank, 8 to 12 in. wide and from 9 to 11 ft. long set on two roadway posts. When timbering failed, due to slow rate of advance, the rooms were either abandoned or the slate was loaded out after the gob was filled.

5th—The pitch of the vein, together with the absence of water, permitted rooms to be turned both right and left at 90° angles from entries driven either on the face or on the butt.

6th—Entries were driven from 9 to 12 ft. wide. The draw slate, if unsupported, invariably fell regardless of entry width. Top coal and shale sooner or later followed until the bottom of the limestone was eventually exposed.

The success of any mining operation depends upon the results obtained from the working faces of the greatest source of production; namely, rooms or rooms and pillars. Mechanized production requires a complete and detailed plan of attack on the working face. The keynote of the plan should be simplicity. Also, the plan must be flexible to a degree in order to cope with unusual conditions. Complicated plans breed high costs.

Powhatan's problem was the economical mechanized loading of coal in rooms having roof of average Pittsburgh vein draw slate. A plan had to be evolved which bore promise of meeting the requirements effectively, forecast an appreciable reduction in costs, and gave consideration to capital outlay.

Loading, transporting, segregating and disposing of rock is costly. Could Powhatan slate be held in place for less? It was believed it could be if one assumed that rapidity of room advancement would react favorably as far as draw slate and general roof actions were concerned, and that extensible steel roof jacks, used singly and in conjunction with steel "H" beams of light section, would provide quick, flexible, adequate, and temporary roof support.

The loading of coal by duckbills onto shaking conveyors had been proven, and this system seemed to lend itself to room mining where close timbering and rapid advancement were involved.

Based on the above observations and assumptions, as associated with performance records of mechanized mining equipment, recommendations were made covering a mother belt with duckbill loaded shaking conveyors for room work and mobile loaders for entry development.

Commitments having been made as to mining equipment, the next steps involved providing adequate ventilation, power, and transportation facilities for the anticipated highly concentrated mechanized tonnage. It is far better to have these allied services awaiting the mining equipment than the reverse.

The plan for Powhatan called for a maximum of two entry-driving crews and a mother-belt crew working in a panel section simultaneously. Two such panels are now in operation and a six-entry main is being extended.

To provide adequate ventilation for the diffusion of gas from the rapidly advancing rooms and entries, and to provide ample fresh air for the facemen, a new fan was placed upon a new shaft, an extra airway was projected for all face entries, and old airways were cleaned. Power requirements were carefully computed. Generator sets were moved to new locations, miles of positive and return cables were moved and purchased, and bonding was checked and double-checked. The main entry within the working area was provided with double track of heavy materials and side tracks were installed. The face entries were likewise double-tracked and frequent cross-overs laid to assure no blocking of main haulage and servicing haulage units.

In March of this year the five mobile loaders used in advancing 17 entries and 20 conveyors in an equal number of rooms produced a daily average of 5,687 tons from a total of 37 working places.

Development for a mother-belt set-up consists of three 12-ft. wide entries driven on 50-ft. centers and 1,200 ft. in length. Staggered cross-cuts turned on 38-ft. centers on each side of the middle or belt entry provide ventilation on the advance and later act as room necks in which the drives for the shaker conveyor are set. Production begins at the inby end of the belt. Five conveyors feed the belt from each side. Rooms are from 28 to 30 ft. wide and are 350 ft. long, measured from the center line of the belt. Center lines or sights are set in each room in order to govern room widths and conveyor-pan alignment. Every seventh room on each side of the belt is left unmined. These "blocks" act as checks on roof subsidence and assure subsequent complete room extraction. A service track is employed in either of the outside entries to facilitate the handling of supplies and assist in the removal of material and equipment when all mining has been completed in the entry.

The belt-unit equipment consists of a 1,200-ft. 30-in. troughed belt conveyor; a 10-hp. slow-speed hoist for moving a 40-car trip past the loading head; a caterpillar tractor for moving conveyor drives, duckbills, mining machines, etc.; a telephone; and, for each room, a shaking conveyor with duckbill attachment, a 50-hp. shortwall cutting machine with 8-ft. 6-in. cutting bar, an electric post-mounted drill, steel "H" beams, and extensible steel roof jacks.

A complete spare head-section and a tail-section plus 20 intermediate sections with belt are carried to facilitate quick moving. This equipment is set up for the succeeding belt installation. As intermediate sections are reclaimed from the two retreating belts they are added to the new installation until it is completely extended. Spare mining machines, drills, armatures, cable and miscellaneous repair parts for all operating equipment is carried in the inside shop.

As has been previously indicated, roof support in rooms is classed as temporary and permanent. The temporary support consists of steel extensible roof jacks and 4-in. "H" beams weighing 7½ lb. per foot and 18 ft. in length. Each room is provided with from 35 to 40 jacks and 7 steel beams. The beams parallel the face, are spaced on 4-ft. centers, are supported by three jacks, and are set flush with the right-hand rib. The position of the inside beam is 2 ft. from the face before the cut is shot. In loading out the right-hand half of the face it is necessary to reset only the center jacks while the duckbill traverses from center to rib on snub-shot coal and from rib to center for the top bench. In the left-hand area single jacks with cap pieces are set as needed. The required practice is to support newly exposed roof immediately. As the cut is being loaded out single jacks are set and two beams are placed as quickly as sufficient space permits.

Permanent timbering is systematically advanced by the floating labor crew. The principal support consists of 3-in. x 10-in. x 13-ft. plank set on three wood posts. Plank are aligned, span the conveyor and provide a safe timbered traveling way for men and equipment. Extra plank are set where unusual conditions warrant. Two rows of posts are stood between plank ends and ribs. Two plank are placed for each cut removed and are set between the time that a cut is loaded out and the beginning of the next cut. The plank are spaced between the first and second and the second and third beams towards the room neck before those beams are removed. Steel jacks to the right and left of the newly set plank are replaced by posts at the same time.

LARGE TRANSFER CARS, TRANSFER STATION AND TRACK HAULAGE FOR MECHANICAL LOADING, by David W. Jones, Gen. Supt., Princeton Mining Co.

The large car has done its greatest good for coal-mine haulage by doing away with the most hazardous of all classifications, the trip-rider. Throwing switches on the run, coupling cars on the fly, splitting trips by crawling between cars, riding cars when out of control, attempting to outrun cars, and jumping on and off moving cars and locomotives are all eliminated. It is not merely the elimination of but one hazard, but the combination of many of them, for in nearly every case when an accident occurs it is the result of confusion, congestion, or haste. Mine cars are the predominating equipment in a coal mine. Consequently, they have the greatest opportunity for creating most of the hazards. The large cars will reduce the man-hours of exposure of men engaged in haulage work in the ratio of 2½ to 1, or 5 to 2, which is 10 to 4 Therefore, the possibilities for haulage accidents have been reduced in the ratio of 100 to 40, which is 60 percent. It is hoped that the large cars will prove to be a definite factor in making possible a creditable showing for safety in coal mines.

DAVID W. JONES

Another feature of the large car haulage is the matter of clean haulage roads. In loading such a wide car, 7½ ft., the loading machine cannot spill coal on the sides of the track, and whatever does fall off goes into the timbered areas in rooms or along the ribs in the headings. In rooms the timbers must be carried close to the car sides and any coal falling will be at least 2 ft. from the track. In the headings, the track will always be clean at least 2 ft. on each side of the track. The difference in clean roads where the large cars are used as compared with places where small cars operate is quite noticeable. Also, less spillage from cars is due to the fact that there are two and one-half less cars in transit on the large-car runs than is the case on small-car runs. By eliminating coal spillage along the track in the large-car runs, the dust in the air is reduced to a minimum. This accounts for the rock-dusting in the large-car runs being more effective and requiring less frequent application than on the runs where there is a greater number of car movements to make dirty roadways.

The number of car derailments possible is reduced in proportion to the reduction in cars handled. Without considering the fact that the large car is more stable on the road than the small car, there are two and one-half small cars in transit to one large car, or five to two. Everything else being equal, there are five chances for derailment of the small cars to two for the large cars. Large-car derailments are very infrequent and it is true that, due to their size, it is impossible for them to get very far away from the track when derailed. Due to low clearance and bulk, they cannot be dragged or pushed while off the track. It is a simple job to rerail a large car by blocking up the wheels to a height sufficient to clear the flange of the wheel and then dropping it into the track gauge. The same conditions are not true when a small car leaves the track, as it might go a considerable distance before stopping and do much damage in the vicinity of the derailment.

An indirect safety feature of the large car is the fact that haulage men are less likely to misjudge close clearances. Many haulage accidents have occurred due to men taking chances and being caught by misjudging the clearances of small cars. With the large cars, no attempt is made to judge clearances and every precaution is taken to be safe and sure that there is ample clearance for the large cars.

SHUTTLE CAR HAULAGE AT MINE NO. 43, PEABODY COAL CO., by S. L. Anderson, Supt., Peabody Coal Co.

The unit chosen for this experiment has been averaging approximately 230 tons per 7-hour shift, loading directly into pitcars. Before the 1st of January, 1940, this same unit, using the shuttle cars for service haulage, had loaded over 600 tons for one 7-hour day and was consistently loading over 500 tons per shift.

The general benefits derived from the installation of shuttle cars are many, the first being, of course, the increased tonnage loaded per loading-machine unit. The increase being possible without additional effort on the part of the workmen and, in fact, the management has been petitioned on several occasions by men working on track units seeking to be transferred to the shuttle-car units.

Concentration of work is another advantage. Working places work out much quicker, thereby reducing costly falls where rooms are allowed to lag.

Last but not least by any means is the reduction in face accidents on the shuttle-car units. Better supervision probably is the contributing factor in this reduction. On the track loading units each section foreman has 30 to 35 men under his direct supervision, while in the shuttle units each foreman has 16 to 20 men. The complete cycle of operation for shuttle cars requires not over six working places, or, in other words, all of each foreman's work is confined to not more than six working places at one time. This means that each man working on a shuttle-car unit is practically under the foreman's direct supervision at all times.

For the year of 1940, 311,278 tons of coal was loaded by the six shuttle-car units with six lost-time accidents, or 51,879 tons of coal per lost-time accident.

In conclusion, the shuttle-car system of trackless haulage, in our opinion, has to a large extent eliminated most of the delays found with the track units. The loading machines operate a larger part of the day, thereby giving an increased tonnage with a much smoother operation.

AUXILIARY FACE OPERATIONS, by A. E. Duckwall, Chief Engr., U. S. Coal & Coke Co.

All operations must be termed as "auxiliary" except that of loading the coal from the seam and depositing it into the mine car, or any other means of transportation employed to get the coal away from the face. There are several methods employed to load this coal; for example, hand-shoveling or mechanical loaders; and each requires different types of auxiliary face operations.

A. E. DUCKWALL

With hand-loading, the auxiliary face operations are not as important as with mechanical loading equipment. In the first instance, the loading is usually done by one man on a piece-rate basis, whereas in the case of mechanical loading a crew of possibly 16 men is required. A delay of 30 minutes in the first instance is only the loss of 30 minutes, while in the latter case it is 480 minutes, or 8 man-hours.

With the advent of our mechanical age, the problem of actually loading coal into the mine car becomes only of minor importance as compared with the many auxiliary operations necessary to prepare the working place for the loading operation. If all coal seams were of the same thickness and were overlaid with the same top and underlaid with the same bottom, covered with the same overburden, the mining industry could standardize some of the many operations which are now determined in many instances by experience, much of which is costly to acquire. Due consideration must be given to each of the "auxiliary operations" incident to the "loading operation" of coal under the many varying conditions encountered.

Auxiliary Operations

1. Ventilation, so necessary to the safe performance of any and all operations, should be in ample volume and should be placed first. We need not go back to the main ventilating fan, but will assume that in every properly operated mine adequate ventilation is maintained at the working face and that separate splits are employed. Dealing directly with the live territory adjacent to the working face, the method employed to ventilate is dependent upon the mining system used and the equipment employed. If room and pillar, the ventilating current can be carried to the face by driving breakthrus, stringing line brattice, or by blower fans with tubing. If open-end retreating system is used, the ventilation can be accomplished by maintaining a good current of air across the working face. Concrete examples of face ventilation will be described in dealing with the various systems of mining employed in high and low coal, both hand and mechanically loaded.

2. Roof support is the next auxiliary face operation to be given consideration, as it is of prime importance to make the place safe for both men and equipment. This operation at some mines under extremely heavy overburden, such as is the eastern Kentucky field where as much as 2,000 ft. is encountered, becomes a vital operation. In other fields where the mining is under lighter cover and more favorable roof conditions exist, timbering is almost negligible.

3. Drainage, while more vital to hand-loading than mechanical, must be considered before the working place is in loading condition. Places to the dip are many times too wet and must be dewatered, while those to the rise are dusty and must be sprinkled. No mine operator intentionally loads excessive water in his product, inviting and attending difficulties in its sizing and preparation, as well as creating unloading difficulties in freezing weather. The absence of moisture is frequently met, producing a dust hazard—a subject which only recently has come to be given the serious consideration it merits.

4. Cutting coal mechanically has done more toward increasing the output per man than any of the auxiliary face operations. Its efficiency is so generally conceded that only in rare instances is coal mined from the solid. In eastern Kentucky, under excessive cover ranging up to 2,000 ft., using a modified longwall retreating system, successful and efficient mining can be accomplished by cutting only about 50 percent of the coal. This practice, however, is being discontinued due to the added degree of safety afforded the loader through cutting the coal, thus

eliminating the frequent outbursts from the face, which were always hazardous. Coal-cutting machines must be selected for the particular conditions under which they must operate and the type of equipment they are to be used in connection with. Occasionally a longwall machine will be found more efficient in wide rooms where roof conditions require timbering close to the face. For development work, this type machine would be useless. Thin-seam coal requires the use of cutting equipment with a minimum height, whereas in high coal the track cutting machine has rapidly grown in favor.

5. Drilling, while yet a prominent operation in the preparation of coal for either hand or mechanical loading, is gradually being combined with cutting. Here, as with all other auxiliary face operation, no standardization is possible for all coals. With the advent of coal-breaking devices, drills with augers as large as 5 inch have made their appearance. Electrically actuated units are gradually replacing the hand-operated breast drill in the preparation of coal for hand loading, and track-mounted units where mobile loaders are employed.

6. Shooting, like other face operations, cannot be standardized, but the medium must be selected for the conditions under which it is to be used and the use, or market, to which the resultant product is to be put. The reusable charge device has been gaining favor in connection with mechanical loading, due to the saving in the time of the loader's return to the working face after the coal has been dislodged To the domestic coal producer, the prime requisite of the shooting medium is the production of a maximum of lump and a minimum of slack, while to the steel maker and coke producer the opposite is equally true.

7. Gathering, so vital to the success or failure of every coal mine, is dependent upon careful planning, good track, and suitable equipment with efficient operators. Even this operation cannot be standardized, and likewise there are always exceptions to any given rule. With the advent of the rubber-tired "transporters," the use of track in some mines is eliminated, and at other mines, through the use of underground conveyors, the entire gathering operation is omitted. These are only exceptions. The success of any coal mine is measured by the efficiency of its transportation system, with particular emphasis on the gathering at the face. The need of this emphasis is very apparent to any mining man when he witnesses the time lost through the change-out of cars at a mechanical loader. This flagrant loss is instigating serious study relative to the use of large cars at the loader and transfer facilities to smaller cars at a point reasonably adjacent to the face, thence main-line haulage to the tipple, or shaft bottom.

8. Moving, while of no vital importance with track-mounted mobile loader, becomes very important in connection with conveyors. Systematic planning can reduce this loss in time with its attendant interruption of production, but cannot totally eliminate it. The loss in time depends upon the system of mining and the degree of mechanized transportation. Time studies made on three successful installations over a period of months indicate that of the total man-hours consumed in producing coal with conveyors, occasionally as much as 10 to 12 percent is consumed in the operation of moving.

Power Distribution for Mechanical Loaders and Conveyors, by R. L. Kingsland, Electrical and Maintenance Engr., Consolidation Coal Co.

Orderly development of mine workings, with projection made for at least two or three years in advance, is quite essential. The system of ventilation must be given careful study, as well as the system of mining. If proper ventilation is not provided serious complications in the type of equipment and wiring system will develop. Various state laws concerning gaseous and nongaseous mines must be considered. Locations for substations must also be projected in order to have the fewest number of stations and also the fewest number of moves for stations for a satisfactory power supply.

R. L. KINGSLAND

Concentration of face workings and of electric power demand are economic parts of mechanization. D.C. stations must be located at or near the center of mechanized operations. For 250-volt equipment a station should be kept at not less than a mile from all face equipment. It is not economical to put too much capacity in substations for this class of work. Three-hundred-kw. stations have been found satisfactory for a lot of installations, and where main haulage and face equipment are both served from the same station two 300-kw. units have been used. It will seldom be necessary to install more power than 600 kw. in one station. Substation equipment can be track-mounted, and mobile; and A.C. power system must be extended each time station is moved. If the substation is installed underground this requires high-voltage cables in the mine or a new bore hole at each location. High-voltage cables along headings in the mine are hazardous and in some safety rules are prohibited. The important factors for each job must be studied before deciding on the type and location of substation equipment. These should include nature of roof and bottom, height of cover, ventilating system, power supply, first cost, operating cost and reliability. In mechanized mining the life of a substation location will be comparatively short, and therefore the equipment and building should be made as mobile as possible and the expenditure for foundations that cannot be moved should be kept to a minimum.

Conveyor Mining in Alabama, by F. J. Immler, Asst. to Chief Engr., Alabama By-Products Corp.

Alabama coal seams are of two main groups: either thin clean seams of high quality, or thicker seams with heavy partings and of lower grade. In Alabama a thin seam ranges about 24 in. in height; a thick seam would be 48 in. or better.

Seldom are there desirable roof or bottom conditions; faults and rolls are numerous, many mines are wet, and most of them give off large quantities of methane. In terms of tonnage mined and miners employed, Alabama coal mines may not loom so large, but in terms of difficulties encountered, Alabama will come pretty close to being the No. 1 mining problem.

F. J. IMMLER

Historically, coal mining in Alabama is very young, the first mining of record having been made in 1870. This is a slight digression, but do wish to list the growth of production by major steps from that date:

Year	Production (tons)	Year	Production (tons)
1870...	13,200	1917...	20,413,811
1876...	112,000	1926...	21,508,812
1883...	1,568,000	1934...	9,600,792
1902...	10,329,479	1940...	11,995,000

It is rather startling to note that production is back to where it was 40 years ago.

The adverse mining conditions have constantly been a menace to the economic stability of Alabama's mining industry, and for that reason the mines have always been quick to adopt every modern means for beneficiating the cost. Under the former universal method of hand loading into tramcars it was early realized that some form of mechanical aid must be given the hand miner, and one form of this aid has been the adoption of conveyors.

Alabama has pioneered many of today's successful methods, machines, and appliances; the conveyor is no exception. In the year 1922 the Montevallo Mining Company installed shaker conveyors in their Aldrich mine. This was the first conveyor installation in Alabama and the first shaker conveyor installation in the United States. Other similar instances could be cited.

These conveyors were a solution to certain adverse conditions peculiar to Aldrich mine, but other mines in Alabama began to evince an interest, and by 1928 conveyors, as we now understand them, were beginning to come into prominence.

Pitcar loaders may be considered as a form of conveyor, and by 1928 they, too, were in use at many mines. Pitcar loaders served to bridge the gap between the hand shovel and the tramcar, but as conveyors proper became more appreciated, the pitcar loaders were discarded.

The bad natural conditions of Alabama seams, plus the fact that the mine workings have advanced by now far from the outcrops, has also contributed to the adoption of conveyors. A further and sturdy impetus was given when the mines were organized in 1934, with the resultant constantly higher labor cost; now, with governmental price-fixing, we must look to an ever-increasing use of conveyors to get more coal off the working face with less man-hours.

In the thin clean seams, the conveyor has found ready application, for it fits into existing conditions with minimum disturbance. In thick seams, the heavy included partings have obstructed the more general use of conveyors. The practice is to gob the rock at the working face and with such large quantities of rock to handle, the coal loading becomes of subsidiary importance. The preparation plants—and please note that 80 percent of Alabama's coal is washed—are in existence at nearly all mines, but they are geared to handle the mine product on much the former basis of selective mining at the working face, so until they are enlarged, or, which is the same thing, it is proven that face selectivity is unsound, then the conveyors must still operate to handle coal containing the usual amounts of washer rejects. We personally think that the trend will be towards larger washer and preparation plants and less selective mining at the face. This will favor a wider use of conveyors in the thick seams.

As an exhibit of how conveyor loading

stands at present, we offer the tonnage as of 1939:

	No. of units	Production, tons
Hand-loaded conveyors	130	1,067,799
Shakers—both hand & duckbill	92	1,001,427
Mobile loaders	18	570,626
Scraper loaders	37	364,985
Hand loading	..	8,467,469

In Alabama, both shaker and chain-flight type conveyor are used impartially on room-and-pillar, longwall, or modified-longwall work. The bulk of the coal conveyor mined is by hand loading onto conveyors, but there are many successful applications of the self-loading conveyor, and several large operations load onto conveyors by mobile loaders. A few of the mines are using belts in connection with conveyor loading and have experienced economies from this kind of operation.

Conveyors have been very successful in Alabama and have helped facilitate the mining of seams under all the adverse natural conditions inherent to the district. Direct savings have been affected on the actual face-mining cost; that is, cutting, drilling, shooting, and loading; but not to a large extent. The major savings have been made by the change in system, the concentration of mining, the elimination of carrying tramcars to the room face, the working of miners in larger groups, the closer supervision possible, and the greater safety made possible by conveyor mining.

By the installation of conveyors the tons per man on the face may be increased some 25 percent, and the cost per ton may decrease 15 to 30 percent of the cost at the pit mouth.

Power usage has increased, capital expenditures have been large, and very often the experimental and initial stages have been costly when conveyors have been installed. However, they have a fixed position in Alabama mining, and Alabama miners have done a remarkably good job and have shown great ingenuity in adopting them to all the hard conditions with which Alabama coal seams are cursed.

Conveyors can find and will find a still wider application at the mines. No doubt they will be greatly improved, and in time they will be entirely supplanted by something still better. When this time comes, you may be sure that Alabama mines will be among the first to adopt the better ways.

Economics of Gathering Belts with Mechanized Mining, by **Carel Robinson**, Consulting Engr.

It was found that in seams 30 in. in thickness an average of $.030 per ton covered all operating expenses, including supervision, extension and reduction, maintenance labor, etc., on lines over 2 miles in length. The replacement of belting, idlers, and other parts over periods of four and more years amounted to slightly less than $.01 per ton. In seams 48 in. and over in thickness, the operating cost is less than $.01 per ton, and replacement cost less than $.005 per ton. A rule-of-thumb for these costs is as follows: One belt patrolman on each shift for each 5,000 ft. or less of belt conveyor; 6-man shifts per 300 ft. of belt extension or reduction; replacement of belts in new installations, one-third of overall in three years, one-third in five years, and one-third in eight years. These figures naturally are not accurate, but do provide a method of tentative calculation.

An interesting feature is that all of these figures are constants. That is, 300 tons per hour can be handled for practically the same fixed cost that is required for 100 tons per hour. On permanent belt installations, skillfully installed, replacement is very nearly proportional to tonnage. On the whole, belts on extensible belt conveyors today are torn or destroyed tnrough carelessness or faulty installation long before the full life of the belt has been reached. That is, hours of use, rather than tons of coal handled, determine the need for replacement. Naturally, there are a few notable exceptions to this broad statement where the mine management has used sufficient skill.

CAREL ROBINSON

A valuable characteristic of belt conveyors is that natural conditions need have little effect on the belt cost.

The indirect economics of belt conveyors are numerous, but are hard to evaluate in dollars and cents. For general consideration, a brief list is presented. Any operator considering the use of belt conveyors should check this list, or one of his own composition. For any given mine, generally these factors can be approximated satisfactorily. Naturally, certain conditions are encountered where the entire list may mean little; in others, a great deal.

I. An average of less than five minutes' delay per shift caused by the transportation system can be anticipated with belt conveyors. This figure is based on actual performance over a period of years. This small delay time looms large when the delays of mine-car transportation are considered—wrecks, derailments, broken rails, power lines down, faulty dispatching, and all the other countless causes.

II. Belt conveyors are very definitely less hazardous than mine-car haulage. A number of mines operate for years without personal injury from transportation. This contrasts with the severe accident rates in all states with mine-car transportation. For example, in West Virginia 158 men were killed and 2,578 were injured in haulage accidents in 1940.

III. Belt haulageways can be timbered at less expense and more effectively. The span over the belts between posts need be only 3½ ft., as compared with 7 ft. or more with mine cars. There is no danger of knocking out timbers on belt lines, and accordingly many places can be safely timbered that would be traps in the event of derailment with mine cars.

IV. Transportation problems are virtually eliminated, thereby allowing the higher management to concentrate more time and effort on face performance, with resultant decreased cost.

V. In rolling, faulty, or irregular seams belts can be used efficiently where mine-car haulage would be expensive, or even prohibitive.

VI. Since belt conveyors are only 18 in. or less in height, no change in haulage equipment is required where seam conditions change radically.

VII. By simply changing speed of a 30-in. belt conveyor (provided equipment is so designed), tonnages ranging from 100 tons per hour to 400 tons per hour can be efficiently hauled.

VIII. Power cost is generally cheaper than with mine-car haulage, due to steady load creating no peak demand. A.C. power can readily be used, and thereby further decrease power cost.

IX. Frequently, where it is desirable to have a haulage road on the return, and either state law of company policy prohibits, a belt can be utilized, provided a manway is provided on the inlet.

Disadvantage of Belt Conveyors

I. Frequently belt conveyors have a higher initial capital cost. In a surprising number of cases, however, this need not be true.

II. The belting of belt conveyors is essentially fragile. Constant and expert maintenance is an absolute necessity. Proper safety controls must be installed and maintained. Expert care must be taken to set up loading points properly. Unless these points are followed always, very costly damage to the belting can be expected.

III. Where the mine floor is subsiding, or where there is much movement of the mine floor, belt lines may get out of alignment and either cause damage or delay while the situation is corrected.

IV. Belts do not provide storage to permit continuing work at face when there is a delay at the tipple end. A storage bin is frequently required.

The Effect of Mechanization on Managerial and Supervisory Problems, by **James Hyslop**, Gen. Mgr., Hanna Coal Co.

Mechanization has changed the mine management requirements in many ways, as follows:

1. The number of supervisors per unit of output has been more than doubled.
2. The supervisory personnel must be of a superior type.
3. Mine management must now possess a greater degree of engineering skill — mining, mechanical, civil, and chemical.

JAMES HYSLOP

4. More careful attention must be given to the human relations and personnel problems within the management organization and as they apply to labor relations.
5. More careful long-range planning and projections of operations is required.
6. It calls for imagination and initiative in developing new methods and technique in operation.
7. Management must broaden its knowledge of the activities and developments throughout the industry, in order to meet competition.
8. The economics of the industry are subject to rapid shift. Therefore, a more comprehensive understanding of the coal business is necessary.
9. Management must keep itself informed concerning the situation arising out of efforts to regulate the industry by legislation.

In mines where natural conditions are highly favorable the problem is much simpler, and a lesser amount of supervision is required, and it need not be of such high quality. One of the effects of mechanization has been to greatly emphasize the effect of adverse natural conditions on mining costs. Efficiency is more easily obtained where a definite working routine can be established but where new problems are constantly arising through adverse or varying natural conditions, success depends entirely upon effective leadership. It follows, therefore, that the section foreman or other sub-official must possess capabilities and qualities superior to what was generally found amongst men in positions of similar responsibility under the older mining methods. Management is faced with the job of developing supervisory personnel

capable of carrying these new responsibilities.

Since the number of supervisors required is several times as great as under hand loading, and since they should be of a superior type, it is obvious that the necessary supervisory personnel and reserves will not develop spontaneously. A definite program of selecting and training these men must be carried on. It is futile for management to attempt to go out and hire experienced men to build up their organization, as mechanization is progressing so rapidly that there are simply not enough experienced men to meet the demand. In general, these sub-officials must be selected from amongst the miners, and they will have to be trained for their new jobs. These recruits will not develop the qualifications required without training. It seems to me that the industry has failed to recognize the importance of an instruction program for these men.

One of the serious mistakes frequently made by officials is to fail to impress upon the sub-official, such as section foreman, the proper sense of responsibility and dignity. Foremen should be made to feel that they are definitely a part of management. They should be given the confidence and respect of their superiors. Any confusion in the mind of a section foreman as to his relationship to management will tend to incapacitate him for his responsibilities. Each supervisor should understand clearly that he occupies the important position of executing the final phase of managerial responsibility and of representing management to the workmen. It follows, therefore, that the better he is informed regarding managerial problems, the more he will be able to fulfill these important functions.

No one will deny that for some time we have been undergoing important social and economic changes. This is particularly true within the field of the relations between management and labor. The attitude of labor is very definitely a factor in the successful operation of a mechanized mine. Labor is often influenced by misinformation and misrepresentation received from various sources. The company representative whose responsibility it is to supervise the workmen is in a better position than anyone else to promote proper relationship between management and labor and to develop work enthusiasm amongst the workers. He is in the best position to spot malcontents, and he has the opportunity not only of counteracting the influence of but of converting them to sound thinking. Not infrequently supervisors are found to be malcontents themselves, and this is usually due to the failure of their superiors to accord to them the place in the managerial force their work requires.

It is no exaggeration to state that the attitude of the workmen can make or break a mechanized mine. The miner is a human being, and his mental and emotional attitude toward his work has a profound effect on his efficiency. Men either like or dislike the company; they are enthusiastic about their work, or their tasks are drudgery to them; they are anxious to accomplish something, or they are indifferent about the result of their efforts; they are safety-minded or careless. Other industries have for many years recognized the importance of worker psychology, but we are just now beginning to think about it. The coal industry has today certain advantages over other industries, in that the latter are in the throes of making the adjustments occasioned by their labor having been only recently organized, whereas in our case most of the problems with which they are now wrestling have been settled for some time. The coal industry should begin to realize the possibilities for progress in the field of personnel work. In the mine, the supervisors should be capable of understanding that these problems exist, and management should see to it that the supervisory force is trained to successfully handle this task.

The supervisor should also be made responsible for the safety of his men. Compensation laws place the responsibility for the safety of the workmen upon the employer. Since the supervisor represents the employer to the employe, it follows that he must ultimately be responsible for the employe's safety. Sometimes, attempts are made to solve the problem of safety by placing all such responsibility upon a safety director, and, while no one would question the need for safety directors, unless the supervisors are capable of functioning constantly as safety directors amongst their men, the safety department, no matter how elaborate, will fail.

Modernization has changed not only production supervision, but other phases of management as well. We now must have closer coordination of operations and sales, the importance of quality control has called for a much more extensive analytical and inspection department; fixed prices have developed a more delicate relation to competition. All of these factors require expansion, revision and improvement in the field of coal mining management. The challenging situation calls for exertion on the part of every wide-awake executive.

Underground Dragline Conveyor, by A. Fred Phelps, Supt.,* Pardee & Curtin Lumber Co.

Those mines which mine thin seams or which have adverse natural conditions find themselves in a very unfavorable position. While great improvement has been made in mechanical mining equipment during the past few years most of this equipment has been adapted to thicker seams which have good natural conditions. Chain and flight conveyors, shaker conveyors with or without duck-bill, belt conveyors and low type shuttle-cars have met with some success under certain conditions but still leave much to be desired in most low coal mines.

The Pardee & Curtin Lumber Co., operating the Sewell seam in Webster County, W. Va., realized as early as 1933 that some form of mechanical mining was becoming more important and that whatever system was to be adopted would have to be tailor-made for the Sewell seam in that part of the world.

Early in 1934 extensive experiments were conducted to try to discover a workable system of mining this seam with a track mounted loading machine and two room conveyors with the necessary cross conveyors, face conveyors, drills, car spotting hoist, etc. These experiments were disappointing from a production standpoint, due to the varying seam height, frail top and extreme grades encountered. It was demonstrated, however, that for advancing headings these chain and flight conveyors were very satisfactory. Other units have been purchased from time to time until at the present time eight of these conveyors are in use on development work.

In 1939 it was decided to experiment with a drag conveyor handled into and out of the working place with a double drum hoist located on the heading and provided with a ramp on the heading to locate and properly position this sliding box at its dumping station. Drawings were made and one of these units was built in the company's Bergoo shops.

This equipment has some distinct advantages over other types of equipment adapted to the same conditions. The absence of noise at the face is much appreciated by the men at the face and this is a distinct advantage in bad top. The ease with which the equipment may be moved out of a room in case of impending top difficulties is another advantage. In cases where pillars are not taken in low coal, moving time is reduced with a definite reduction in moving and handling cost; while in higher coal the fewer parts to handle and the ease with which it may be handled results in shorter set-up time as well as shorter moving time with less interruption to production. In case moving is over a long distance all the unit may be loaded on two flat cars and moved with a minimum of time and expense. The work of the face crews is reduced as it is only necessary to move up the face sheave to be ready to load after the face is prepared for loading. The handling of material to and from the face is a simple matter as the box will haul anything needed at the face. In case anything should occur to the mining machine that will require it to be brought out of the place the head and tail ropes provide a ready means for doing this. Maintenance cost is very low.

This system of operation is not proposed as a "cure-all" for the troubles incident to low coal mining. Development so far has shown some of the possibilities of this system and it is hoped that further experiments may result in equipment that will be of value to the industry as a whole.

Strip Mining

Exploration for Coal Stripping, by Walter B. Roe, Geologist, Truax-Traer Coal Co.

Because strip coal is relatively near the surface, it is usually possible for the prospector, on entering a new area, to find some outcrops of coal along the stream valleys unless the area is practically devoid of relief, with no streams cutting deep enough to intersect the coal horizon. If these outcrops are present, they usually give fairly good clues on which to base a preliminary estimate of the thickness and area of possible strip coal. It may also be possible to get a face sample for analysis, and some estimate of the depth and composition of the overburden may be gained, if the overlying material is exposed in the outcrop. At least the depth of maximum overburden in the area can be estimated by comparing the elevation of the coal outcrop with the elevation of the uplands nearby.

This preliminary examination of the area should enable the prospector to determine with reasonable accuracy the area of available strip coal, the shape of the field, depth and character of overburden, and thickness and quality of coal. The estimates made on the evidence gained thus far determine whether the field is worthy of further prospecting by a systematic drilling campaign. If the answer is favorable, drilling is begun to fill in the gaps in the information gained from outcrops, wells, published records, etc.

Drilling is usually best started along the highest ridges or uplands, where all strata overlying the coal will be cut by the hole and the maximum depth of overburden determined. These first key holes are profitably drilled to some depths below the coal, for correlation purposes, and more particularly to find out if any other coal lies below the vein in question, which might be confused with it in any of the later drilling. Intelligent correlation of these key holes, and of later holes with them, will often eliminate much unnecessary drilling, both by eliminating entire holes and drilling other holes to unnecessary depths, to be sure the coal horizon is reached. This is particularly true if more than one coal does exist in the area or the coal being prospected dips or rolls considerably. Elevations of the collar of all holes should be determined to aid in this correlation of the drill logs. From these key holes the drilling is ex-

* The convention learned with profound sorrow that Mr. Phelps had passed on before this paper was presented. It was read by J. H. Edwards, and serves in a sense as a memorial to Mr. Phelps.

panded outward until the outcrop or prohibitive overburden depth is reached.

Drill hole pattern is determined largely by the contour of the ground, but if this factor permits, some regular system of spacing is usually followed. The distance between drill holes is determined by the regularity or irregularity of conditions underground. If the overburden and coal are consistent in depth, thickness and character, few holes will suffice, if not, many more holes will have to be drilled to give a complete picture of the prospect.

The elevation of the coal is important for correlation purposes, where more than one vein occurs in an area, to determine the dip, and whether the coal rolls to any extent. If correlations of strata are incorrect, two coals at different elevations can give the appearance of one rolling vein, or a rolling vein can give the effect of two coals. This is where the first deep key holes help greatly.

The drill holes also give a good idea of the physical quality of the coal, as well as its thickness and elevation. The logs should show the presence of dirt bands, pyrite streaks, bone, slabby coal, and its hardness, which will indicate if the coal has been weathered to any extent.

In unglaciated areas the only barren areas in the coal fields are the stream valleys of the present drainage system, which are quite obvious to the prospector. In glaciated areas, however, as in the Indiana, Illinois, Iowa and Ohio bituminous fields and the Dakota, Montana, and Canadian lignite fields, the whole country has been covered by varying thicknesses of glacial drift. This drift often blankets and obscures one or more preglacial drainage systems, which have cut out the coal the same as does the present drainage system, but are not evident on the surface of the ground. In such areas much care must be taken not to assume too much as to the continuity of the coal between drill holes, and closer drilling therefore is necessary. These pre-glacial stream valleys are filled with typical glacial drift or outwash, made up of boulder clay, sand, and gravel, which differs greatly from the residual weathered surface material originating from the local country rock. It is therefore wise to be on guard for a covered pre-glacial channel, when the overburden in the drill holes begin to show any sizeable thickness of sand, gravel, or boulder clay. These channels usually have a definite elongated shape and branching pattern similar to the present drainage system, so can be mapped out once enough holes are drilled to outline them.

Another type of cutout often found in the coal measures, which is equally as obscure as the pre-glacial channel is the sand-stone cutout. These channels were eroded in the coal measures very shortly after the coal was deposited, and are filled with well cemented sandstone of the coal measures formation lying just above, or at some slight distance above, the coal eroded. Consequently if a sandstone, appearing in the drill holes close above the coal, begins to thicken on the lower surface, the prospector can be on the lookout for a sandstone channel or cutout.

Besides these irregularities in the overlying strata there are some unusual changes that often occur within the coal vein from place to place. The prospector is often encouraged by an unusual thickening of a coal seam of otherwise consistent thickness. This is, however, often another warning of trouble as this thickening may be due to interbedded bands of shale, bone, or dirty coal so thin as to be hard to identify in the drill cuttings or even in a core.

Instead of adding to the volume of good coal they may make the whole seam in that area worthless or make more thorough cleaning necessary.

Another irregularity sometimes encountered in the coal itself are clay veins. These are near vertical seams or fillings of sandy, clay-like material, hard or soft, and often mineralized with pyrite and related sulphides, which fill cracks in the coal. These clay veins are easily distinguished, if encountered in the drilling, but as they are of small horizontal extent discovering them is largely a matter of chance. It is therefore possible to get an erroneous impression of their frequency or infrequency of occurrence. They are also very irregular in outline with many horizontal branchings, so that a driller unfamiliar with them might think these branches are dirt partings parallel to the coal bedding. Due to their similarity in character they are often mistaken for fire clay. Thus, if cut at an angle near the bottom of the vein, so that the drill does not again penetrate coal before entering the fire clay, the coal appears abnormally thin.

The hand-operated churn drill was up to very recently the most common type used in strip coal prospecting. In this system the hand auger is used to drill the soil, clay, etc., down to the shale. Then a length of casing, usually two inch pipe, is set on the shale and drill rods, consisting of one inch double strength pipe, with a chisel bit on the lower end run in this casing. The bit containing a ball valve is dressed to just fit inside the two inch casing. The casing is then filled with water and the rods and bit churned up and down in a progressive rotary motion by two men working on a handle-bar, attached near the upper end of the drill rods. At the top of the rods is an elbow and short outlet pipe, from which the water and cuttings are pumped by the up and down motion of the rods. Changes in formation are detected by "feel" and the appearance of the cuttings. On holes more than 50 to 60 feet deep, two handle-bars and four men are used. Eighty feet is about the extreme depth of useful hand-drilling. This method works very well in medium hard rocks, but is, of course, very slow in hard limestone, etc. In such hard rocks, it is customary to replace the pipe rods by solid one-inch bar, to add weight to the tools. Hand-drill outfits are very useful in inaccessible places where it is difficult to move in a machine. Costs, which are almost totally labor, run from 15 cents per foot in easy drilling to over a dollar in hard limestone, etc.

The mechanical churn drill used in drilling strip coal is practically identical to the hand drill, except for the application of gasoline power to lift and drop the rods, and the addition of a weight to the top of the rods to increase the force of the blow on the bit.

Open Pit Coal Mine Haulage, by Eric E. Laurell, Supt., United Electric Coal Cos.

Mr. Laurell's paper appears in full in this issue on pages 16 to 19, inclusive.

Hydraulic Stripping, by R. E. Henderson, Gen. Supt., Pyramid Coal Corp.

In the year of 1939 the Binkley Mining Company of Indiana, at its Bob-o-Link Mine was confronted with the problem of handling a very difficult type of overburden. It was known that the extent of this troublesome overburden would not last longer than 18 months; however, there was no auxiliary tool to assist the 950 stripping shovel in uncovering the coal. The shovel, itself, had the range and the ability to handle this cover which varied from 50 to 70 ft. but the character of the overburden was such that it would not stand in the spoil pile.

On top of the shale we had a stratus of hard pan, over which lay a bed of quick sand which sometimes reached a depth of 10 ft.; on top of this quick sand was the soil ranging from 8 to 15 ft.

After cutting by this with the 950-B shovel, the water saturated sand would come in, bringing the top and completely stopping the operation of the mine. To meet this condition it was suggested that we try to move this by hydraulic mining.

R. E. HENDERSON

To carry out his suggestion, Mr. T. D. Felton, of Bartow, Fla., was called in and under his supervision and direction our hydraulic system was installed. This chiefly consisted of units developing high water pressure with which to cut down the overburden and a pump to pick up and dispose of the overburden so washed down.

Two high pressure water pumps were installed and under the face of the pressure developed the bank, including the sand and soil—a depth of about 20 ft.—was cut down and sludged into a sump at which point it was picked up by a sludge pump. This method of cutting away the overburden lying above the coal seam had the following advantages: (1) a light capital investment, (2) a complete disposition of spoil away from the coal stripping operation, (3) the complete isolation of the operation from the stripping shovel and coal producing operations, (4) a relatively small investment for moving from one property to another, and (5) the possibility of independent operation such as completely stripping a small acreage in the summer to be loaded out in the winter time.

Overburden Preparation—Methods, Practices and Equipment, by Carl E. Walker, Ayrshire-Patoka Collieries Corp.

In the early days of the stripping industry, the overburden at many operations contained little if any material that required shooting. When it was necessary to drill and shoot in advance of the stripping unit, the well or churn type drills were almost universally used. These drills were skid or wheel mounted, powered by steam or gasoline engines and were moved by blocks and lines or teams. Hemp lines were in general use and hole diameters were from 4 to 6 in. Due to moving and operating troubles, footage drilled per shift was very low compared to present standards.

CARL E. WALKER

The easy stripping areas were soon exhausted and the necessity of stripping heavier and harder overburdens has brought the preparation of the overburden forward to the position, where instead of being merely a sideline carried on in a haphazard fashion, it is, under skilled supervision, one of the most important of the various mine operations. Proper overburden preparation means the drilling and shooting of the overburden to allow the maximum efficiency of the stripping shovels at the lowest possible cost and in this cost not only the drilling and shooting charges but also the maintenance and repair costs of the stripping unit must be considered. It is the recognition of these facts, along with the improvements in designs and

materials, that has given us the modern drills of today with a performance surpassing even the wildest dreams of the operators of 20 years ago. Whereas then only the vertical method of drilling was used, we now have three, namely, vertical, horizontal and a combination of the two.

Until recently, to be a user of liquid oxygen explosive meant a large capital investment for a plant and equipment and as transportation difficulties prevented the disposal of any surplus liquid, only those operators capable of using the entire plant output were able to economically afford a plant, but now that the commercial manufacturers of liquid oxygen have entered the field with truck shipments of the oxygen to conveniently located storage tanks, a major obstacle to its use has been eliminated.

Liquid oxygen explosive is a carbonaceous material in a cloth or lined cloth bag or cartridge saturated with liquid oxygen. Many varieties of carbon are manufactured and several kinds are used in the manufacture of liquid oxygen explosive, with divers claims being made for the various kinds used.

Cartridge sizes vary in diameter from 3 to 9 in. but the cartridge in most general use is 4¾ by 21 in., containing approximately 3 lb. of carbon. The cartridges are placed in a specially constructed soaking box after which the liquid oxygen is poured into the box. A pound of the carbon should absorb from 3½ to 4 lb. of liquid oxygen and some additional liquid is required to cool the box and to take care of the loss by evaporation during the loading of the cartridges into the hole. The boxes are then taken to the pit and the cartridges loaded into the holes and detonated with electric blasting caps.

The loading tools are 16 ft. wood poles with bronze hooks and eyes fastened on the poles with copper rivets. A 4-in. "mucklehead" is used on one pole to be placed against the bags to push them back into the hole, while a 5-in. "mucklehead" is used to test out the holes prior to loading.

From one to six cartridges are pushed back at a time and after the explosive load has been placed, tamping, consisting of the cuttings from the hole, in paper or cloth bags, is pushed back snugly against the charge. Holes loaded with liquid oxygen explosive cannot be entirely closed or tamped tightly as is done with fixed explosives so tamping bags used are about 4 in. in diameter thus leaving room for the oxygen vapors formed by evaporation to ecape past them.

From 6 to 14 holes are shot together, the number being determined by governing conditions. When the predetermined number of holes has been drilled, a skip hole is left to be drilled after the adjacent shot has been made. Repeated shattering or the covering up of this hole when drilled prior to the shooting of the adjacent shot caused the adoption of this procedure.

Strip Mine Maintenance, by George E. Nettels, Gen. Supt., Pittsburg & Midway Coal Mining Co.

In the general problem of maintenance we are concerned with tools, materials and men—all inter-dependent on the other. Let us first consider the matter of tools. First and foremost stands the electric welding machine and the oxygen-acetylene torch. It would not be amiss at this point to pay tribute to the men and companies who developed these two remarkable tools. How near impossible it would be to undertake some of the field repairs necessary under our present operating schedules without the machines of today. No doubt many of you recall those days without these two indispensables and possibly wonder how production on any scale was carried on. In addition to these two most important tools, many consider a well appointed machine shop a distinct essential to a sound maintenance program. Materials for repairs and replacement parts have been and possibly will continue to be available in satisfactory quantities. For the most part strip mine operators have relied on the manufacture of any definite machine for repair parts for that machine, but in the past few years there is noted a well defined trend away from that practice. Other manufacturers are duplicating repair parts with alleged improvement in design and quality of material. Opinion on this subject is divided but it is held by the majority that so long as the responsibility of successful operation of any given machine lies with the manufacturer of that machine, then this same corporate entity should be charged with the responsibility of servicing the machine with an abundance of well designed spare parts located at convenient points and competitively priced to the consumer. One of the larger problems facing each operator and particularly at this crucial period, is the question of his own repair parts stock. Realizing that extreme difficulty may be encountered in the days ahead to secure standby parts, this condition may call for greater anticipation of each one's needs. Where he has been thinking in terms of monthly security perhaps this should be extended to a consideration based on a semi-annual requirement. Pooling of effort and stock within geographical units may eventually be the final answer. With the national defense program under full sway this matter of repair parts is likely to become alarmingly serious. Already cooperative work has been done, doubtless more will have to follow.

In the judgment of the writer this combination has done more to keep the wheels rolling than all other maintenance tools combined. It has assumed such an important role in the maintenance and reclamation programs of the strip mining industry, it is difficult to conceive how this industry could function without them.

Among the many factors involved in maintenance, everlasting vigilance in connection with the operation of the various machines, decision as to the time and procedure, possession of necessary tools and replacement parts and an efficient personnel, all these are the ingredients of a successful and economical maintenance.

Planning and Working Smaller Strip Mine Operations, by F. R. Phillippi, Vice Pres. and Treas., Dye Coal Co.

The principal difference between the large strip mine operations and the smaller strip mine operations is usually confined to the type and size of the equipment employed to remove the overburden from the coal seam. While the stripping units employed by the larger strip mines are usually electric powered, and range in dipper capacities from 6 to more than 30 cu. yds., and in weight from 200 to more than 1,800 tons, those employed for the same purpose by the smaller strip mine operations seldom exceed 2½ or 3 cu. yd. capacities and 100 tons in weight, and are usually powered by gasoline or Diesel combustion engines.

F. R. PHILLIPPI

As the effective working range of these smaller stripping units are thus more limited, greater care and caution must be exercised in selecting the properties to be mined, as well as planning their operation.

In many coal fields where the coal seam lies close to the surface, the forces of erosion have left many small tracts or outlying patches of coal isolated from the main body of the seam, and in some instances the entire seam may be made up of many such small isolated tracts or patches of coal. Where these outlying patches become so widely separated by deep valleys or rough terrain as to prohibit the practical use of the larger stripping units, or where the acreage of recoverable coal within any accessible group of such tracts is insufficient to justify the greater investment in such larger stripping equipment, these patches become potential small stripping operations, provided, of course, that the topography of the land overlying the coal, together with other requisite conditions, are favorable for this type of mining.

Frequently there is a considerable acreage of unmined merchantable coal lying from the outcrop up to 30 or 35 ft. of overburden, which has been or will be abandoned by deep mines due to bad top or other undesirable working conditions, which can efficiently be recovered by these smaller stripping units.

Among other factors which encourage the smaller stripping operations is the greater production per dollar of capital investment required, and the short time required to get into actual production. Perhaps these reasons, more than any other, are responsible for the great increase in the number of smaller stripping operations within the last few years.

In planning the operation of the smaller strip operation one must constantly keep in mind the paramount fact that all equipment employed must be very flexible and mobile, and limited in size and weight to the point where it can readily be moved from one tract to another, often over rough terrain, or over public highways under its own power; or, when the moves become too long, by truck and trailer without major dismantling.

To insure consistent production of coal, it is generally necessary to operate the stripping shovels three shifts per day, and seven days per week. This is severe service for this type of equipment and requires a definite maintenance program with a rigid schedule of routine daily inspections and periodic replacements. At our operations we have three mechanics, and a fairly well equipped shop, at which complete assemblies of recurrent replacement parts are continuously being built up, and when replacements are necessary the entire assembly, when practical, is changed.

After the coal seam has been uncovered, and the top of the coal thoroughly cleaned off by means of a bulldozer and then swept by a rotary mechanical broom attached to a tractor, the coal is loaded into trucks which travel on top of the coal seam. The width of the cut of coal removed usually ranges from 28 to 35 ft. depending upon the height of the overburden being stripped at this point. At one of our operations the coal is being loaded with a short range 1¼-yd. shovel used exclusively for this purpose, while at another operation we strip and load with the same shovel, this being the unit previously mentioned with the 38-ft. boom.

After the land has been stripped over, and all the strippable coal removed the operator must now consider what shall be done to again restore this stripped over land to productivity by some general plan of conservation or reclamation. I might add at this point that in Eastern Ohio both the small and large strip mine operators together have formed an organization known as the Ohio Reclamation Committee, of which Mr. William L. Burt, of the Jefferson Company, is chairman,

and each member has the definite obligation to reclaim or plant each year as much spoil bank area as is being mined.

Safety and Maintenance

LUBRICATION OF MINING EQUIPMENT, by Harold S. Lowry, Chief Engr., Snow Hill Coal Corp.

During the past year it became apparent that lubrication was the weak link in our rebuilding cycle in that we were neither sealing the gear cases effectively for any period of time nor putting them in a condition whereby they could be kept sealed economically underground. While this condition was undoubtedly the result of age and capacity demands, we were able to effect very satisfactory results at very little expense. A study of the condition by actual examination and thorough service reports indicated that once a machine began to lose the lubricant from the main transmission case in particular, the loss increased very rapidly and no amount of tightening of joints seemed to have much effect. Loosening of case joints started the leakage and the resultant increased temperature damaged the shaft seals causing still further leakage. It proved to be a case of stop one stop all. Mounting screws were enlarged providing fresh threads, more substantial gaskets and sealing compound employed, resulting in a reduction of loading machine transmission consumption of 60 *percent within* 90 *days*. A new selection of lubricants was also made and considerable savings made in first costs. Results have proven that what we had been attempting to accomplish by the use of expensive greases and compounds was chiefly a problem of mechanical sealing, and that a straight mineral oil of good quality would provide a safe margin of protection with machines operating at normal temperatures and oil consumption.

HAROLD S. LOWRY

Recently at Talleydale we had an opportunity to observe the effectiveness of our transmission oil under what we considered ideal conditions. A loading machine transmission rebuilt and resealed, operating at full time and capacity for the following three months, used 1½ gal. of make-up oil, or about 20 percent of capacity, at a normal operating temperature of 290° F. Destructive distillation tests of samples proved that the oil was still in good condition. The acidity was low and also the non-chloroform-soluble residues, such as metallic oxides and carbonaceous material, indicating little wear of parts and slight breakdown of the lubricant. While such results are, with us, a little above the average, they have served to prove the value of effective lubrication.

We of the coal producing industry are among those to whom the widespread use of mechanical equipment is comparatively new, and we are beginning to discover, as all industry has discovered in the past, that the proper lubrication of this expensive equipment is one important key to efficient operation. We have many maintenance problems which are peculiar to our industry, but we also have, to a far greater extent, the advantage of the experience of our predecessors, the application of which requires only a reasonable amount of knowledge and common sense. It *has been estimated that* 50 *percent* of all *mechanical failures* are due to *faulty lubrication* and if this figure is correct, considering the exposure of most mining equipment to destructive hazards, it is certainly high enough to warrant considerable effort and expense to effect a substantial reduction. We have had in the past a tendency to regard these destructive elements and conditions as a natural, though expensive, part of mining in general. During the past hand-loading period of the industry, this handicap was not too great, but with the advent of our present expensive, precision-built equipment the problem assumes enormous proportions and we find that steps must be taken, not only to protect investment, but to insure by efficient production a cost per ton that will stand rather severe competition.

SAFETY WITH MECHANICAL MINING, by R. H. Nicholas, Chief Inspector, Pittsburgh Coal Co.

The higher executive must have an active interest in safety. Mere wishful thinking on his part will not get results. It has been said, and truly so, that unless the higher executive of the company is sold on safety, the foreman will never be completely sold on it. There is no more effective way to demonstrate a sincere human interest in the welfare of the employes on the part of the executive than for the foreman to be sincerely concerned about the safety of each man and show it in a practical way each day.

The higher executive must take an active interest in the formation of accident prevention policies. He must actively and wholeheartedly support these policies. He must give full support to the foreman whose duty it is to carry out these policies. Nothing can discourage safety more than to have the boss higher up criticize or penalize a foreman for a mistake in discipline.

The responsibility for the accident prevention work should not be delegated to more than one department head. There is plenty of room for the safety director in safety work, but his authority cannot supercede that of the operating head. The direction of the accident prevention policy must flow to the plant supervisors from the head of the production department. The safety director should be a staff officer in the production department and work in an advisory capacity to the department head. Production and safety cannot be separated. The safety director will find it hard to sell an idea to the foreman when the foreman does not desire to comply but it is relatively easy for the superintendent to sell him on the same idea.

To give better protection at the face we devised the wing room. This method of driving rooms gives us a 14 ft. advance face and a wing cut. The face and wing cut combined produces the same amount of coal as we had been producing from the wide face. This reduced the roof area at the immediate face to about one-half what it formerly was. It is nearly four years since we adopted this system and we have not had an accident from roof falls in any place where the system has been used.

Gathering haulage for mechanized loading was started out over tracks that were little better than those used in slower loading practice. Derailments with their attendant hazards were the result. To remedy this condition better alignment, better surfacing, steel ties, and fish plates were made a "must" part of track laying. Closer car changes speeded up the change to the machine and reduced the speed of travel. Larger capacity cars have reduced the number of car changes in some mines and their use is on schedule for other mines.

Faster movement of cars increased hand injuries from coupling. Coupling hooks are now used by all haulage men. Hand and foot injuries resulted from moving switch points with inadequate throwing devices. Parallel switch throws were substituted.

With the introduction of mechanized mining the method of storage, transportation and use of explosives was radically changed. Explosives in bulk had to be transported and stored in the mine. Where one man carried and stored a few sticks of powder in hand loading, the shotfirer in mechanized mining is required to have in his possession sufficient explosives for a full day's machine loading. Bulk transportation and storage of explosives is always a potential source of accidents.

The need for larger and stronger coal sizes led us to use cardox for blasting. In addition to getting better sized coal we got an explosive that could be transported and stored in bulk with comparative safety. By its use we got a controlled charge. Overcharging with its attendant danger from fire and gas ignition was eliminated.

Working without a plan, and disorganized effort is probably productive of more accidents than any other cause.

We had this trouble until the "cycle of operation" was developed and the men educated to follow through. Without a system in which the work flows from one operation to another there is always confusion.

Cycle of operation is not easy to maintain, especially in mines where the roof is not always good, and where the coal seam is broken by clay-veins, rolls and other disturbances. Temptation to pass a bad place is great. Cycle of operation can be maintained when management has an honest desire for it, and when a means of control is established. Multiple shifting can quickly interrupt the flow unless management keeps a close watch over the movement of each place. Each place must move in turn. Every job must be complete in every detail as the cycle unfolds.

Incomplete jobs require that men return to correct them and this is generally done amid the confusion incident to the flow of work being held up.

Tons per man is much safer than tons per machine.

Rapid development naturally follows any form of mechanized mining because of the faster removal of coal from a given area. In gaseous mines, rapid development means faster liberation of methane. Faster liberation of methane increases the hazard from possible accumulations. The hazard from gas accumulation not only affects the individual but can affect the lives of all men in the mine.

We cannot stop rapid development because it is a prerequisite to the success of mechanized mining. Therefore, we must develop a good defense against the danger of gas ignition.

The length of air splits must be kept to a practical minimum to guard against a build up of methane content in the air current. In many cases the percent of methane build up depends upon the number of new faces it passes over.

The separation between the intake and return airways must be constructed and maintained solidly to insure against air losses. This solid separation must be carried up to and include the next to the last break-through in every entry.

Where gas is liberating beyond the last break-through the air must be conducted to the face by line brattice. To be effective the brattice must be solidly supported and reached from the top to the bottom. Where cars pass through there should be a light door erected. There must be clearance between the brattice and the wall to permit free passage of air. Entry development should be arranged to keep to a minimum the use of line brattice to prevent regulating the air flow to

a point where the quantity in circulation would be ineffective.

From an economical standpoint it is necessary to ventilate more than one pair of producing entries with one split of air. This makes it necessary to use doors to separate the intake and return.

The important thing is to use doors in such a way as to insure a constant flow of air through the splits. This can be done by arranging the air-courses so that doors can be erected in pairs at a distance apart to permit the passage of trips of cars without having both doors open at the same time. The penalty for leaving doors open unnecessarily must be severe.

Recommended Practice for Mechanical and Electrical Maintenance, by Frank E. Eubanks, Supt. of Maintenance, Old Ben Coal Corp.

Automatic contractor controllers with their network of wires, their contact relays, push button controls, time element relays and high pressure hydraulic systems, with their control valves, release valves, by-passes and limit devices have so confused the average maintenance man, due to his lack of understanding, that much time is lost, unwarranted damage to the equipment, and unjust criticism to the personnel has been the result of his honest effort to make it go.

On the other hand, it is impossible to have highly trained men who know all the answers; but, I believe that at least a working knowledge of the equipment should be taught those who are expected to supervise or lead in the work of this highly complicated nature.

The average maintenance men in the mines are eager to learn more about the equipment with which they work. This not only qualifies them as more proficient workers, but produces an asset to those for whom they work.

Rigid specifications for the construction of permissible equipment may be given by the Bureau of Mines and the manufacturer will follow those specifications to the last bolt and lock in order to secure the permissible plate. Yet the first time that piece of equipment is in the shop for repairs, its permissibility may be destroyed through ignorance or carelessness.

Too much speed in reassembling and leaving out some of the protective parts has cost the coal operator many thousands of dollars. To insure efficient operation and maximum production, inspection and servicing should be systematic. Frequency of inspection and degree of thoroughness vary and will have to be determined by the maintenance engineer.

Certain Aspects of Coal Mine Safety, by Eugene McAuliffe, Pres., Union Pacific Coal Co.

I propose to make two main recommendations toward attaining a greater measure of mine safety. Let us start out with the premise that a reduction in the number and severity of mine accidents can and will be attained. Some one will take leadership in this movement. Federal inspection is only the first step, and candor compels the recognition of the fact that it was our employes who forced this step. If we continue to maintain a half-hearted position, more and more regulation will follow—all these steps lead closer to complete governmental control and a remoteness from the principle of free industry that has made ours the most puissant nation in the world. Our employes will go along with us if we give them the right kind of leadership. I confess that labor publications ignore almost completely the theory of cooperative effort. Their columns are filled with caustic and too often distorted criticism. In the old half union and half non-union days, the non-union element received all the criticism. With all coal mines now unionized, government regulation and ordering of the industry is pointed as the way out.

EUGENE McAULIFFE

With all the things done that competent operators know how to do, the real task, that of securing the cooperation of employes, remains. The overwhelming percentage of workmen hold a keen desire to do the right thing—too often we fail to even try to take them into partnership. There is a hunger in the souls of all humanity for wider opportunity, the chance to achieve something. If you are a real leader you will try to satisfy this craving. So do your part first, then resolve to show that patient, tactful leadership of your men, that will bring them to your support. These two things will turn the trick.

Unfortunately a great portion of the possibilities of the state inspection forces is destroyed by the political morass that engulfs them, each succeeding state government using these most important positions as a medium for the payment of political debts. To be brutally frank, party support yet bulks larger in the minds of party bosses than does the importance of saving lives, limbs, and the creation of widows and orphans. To summarily oust experienced and proven mine inspectors every time the political wheel turns over is a crime against society. However, there is no great cry as yet among either operators or workers for standards of inspector efficiency and civil service. Should we not explore this situation?

Coal Preparation

General Economics of Dewatering Fine Coal, by C. J. Potter, Mgr. of Prep., Rochester & Pittsburgh Coal Co.

The three basic factors that determine competition in a market are (1) cost of production, (2) quality of the coal, and (3) transportation charges. It has been pointed out many times that a change in any of the three factors, such as an increase in cost, a decrease in quality, or an increase in transportation charges, will tend to eliminate a producer or a district from a market he or it now enjoys. Therefore, if a loss of fine coal increases cost, and inefficient dewatering more than offsets ash reduction, the cleaning and inefficient dewatering may be a liability to the producer, causing a loss of markets instead of the expected enhancement.

Considering these factors, it is pertinent to use concrete examples. For this purpose a comparison is made between a low volatile Pennsylvania and an Illinois strip coal having the following known data:

	Low volatile Pennsylvania	Illinois strip
Cost of production.....	$2.00	$1.30
% minus ½ mm in mine run	10.0	3.0
Selling price of washed ⅝x0	$1.90	$1.20

The selling price of the coal is shown so that it can be seen that there is no question as to the advisability of recovering the coal from a sales viewpoint, and that the selling price is profitable.

If the minus ½ mm coal is wasted, the cost of production of the Pennsylvania coal will be increased 22c to $2.22 while the Illinois coal cost of production will be increased only 4c to $1.34. Assume that the two mines are of identical size, about

C. J. POTTER

500,000 tons per year; then assume an operating cost of $7,000 per year for dewatering, and assume a 5 percent amortization rate for 8 years. It will be seen that the maximum capital charges that can be assumed to pay for the recovery and dewatering of the coal only, and not to regain part of the additional cost, will be about $74,000 for the Illinois plant and about $558,000 for the Pennsylvania plant. Such capital charges will not permit the Illinois plant to completely dewater the fine coal, particularly when quality is considered. However, in the Pennsylvania coal, the loss is so great that facilities can be purchased for about 50 percent of the above available capital permitting a substantial recovery of the additional cost.

Preparation of Stoker Coals—Economic Factors Involved, by Jack H. Price, Coal Sales Mgr., Stearns Coal & Lumber Co.

He stressed the importance to the coal industry in actively promoting the sale of stokers and made the following recommendations:

1. Thus far it has been customary to compute the selling price of stoker coal and resultant small slack by comparing the realization thus obtained with the equivalent realization previously obtained from nut-slack, plus the added cost of preparation. Since the increasing consumption of stoker coal will gradually make it more and more impossible to obtain sufficient stoker coal merely by processing nut and slack, we should begin to base our selling prices on the equivalent realization from mine run.

JACK H. PRICE

2. We should urge the Bituminous Coal Division to increase minimum price levels established on domestic stoker coals so that actual cost of production may be realized.

3. We should engage in and promote active research to determine the most suitable top and bottom size of stoker coal in so far as our individual coals are concerned. There can be no absolute standardization of size, due to a difference in structural and burning characteristics—and we must remember that our job is to furnish a product that will satisfy the consumer. To do this we must depend on research rather than guesswork. In this connection we should compliment Bituminous Coal Research, Batelle Memorial Institute, the Committee of Ten, Appalachian Coals, and other organizations for the extremely valuable work they have done on both coal and equipment research. All of us should actively support their efforts.

4. We should do everything possible to produce a stoker coal of uniform ash content—whether the inherent ash be high or low—the consumer judges ash content by the volume of clinkers rather

than weight—a 1 percent increase in ash content means only 1 percent loss in heat value, which is not noticeable, but the 15 to 20 percent increase in clinker volume is distinctly noticeable.

5. There is strong evidence that double-screened stoker coal, free fron fines, will be demanded by stoker owners for several years to come. Judging from recent years, we may expect this demand to increase at the rate of one and one-half to two million tons annually, thus increasing the production volume of resultant pulverizer slack by one-half to three-fourths of a million tons annually. We should promote and urge the stoker industry to promote the sale of equipment designed to burn this slack efficiently.

6. With stoker coal demand increasing, it appears inevitable that a proportionately greater capital investment in preparation equipment will be necessary—we should therefore adopt marketing practices for domestic stoker coal similar to those used for other domestic sizes in order to encourage uniform movement throughout the year—this is more important when our major investment is in equipment rather than labor.

7. Much of the coal-burning equipment in use today aggravates the problem of coal selection and preparation—we should cooperate with the stoker industry by encouraging changes in stoker design which will minimize this problem—it must be remembered that the stoker is a manufactured unit in which changes can be made when considered desirable, whereas coal is a natural product in which changes are confined to what can be done by crushing, cleaning, washing, etc.

8. An engineer connected with a prominent stoker manufacturer tells me that an automatic ash-removal stoker, burning high-volatile bituminous coal, is a definite future possibility—we should urge and even insist that such a stoker be built, both to widen the range of coal selection and preparation and to make stoker-fired heating plants completely automatic.

9. There is a widespread agitation today in our major cities for the abatement of smoke. This is a laudable civic move and should not be viewed antagonistically by producers of high-volatile coal. We should, however, realize that no fuel is better than the equipment in which it is burned and that if our cities are going to insist on smoke abatement we should in turn insist that it be accomplished through the medium of improved equipment. From a standpoint of equipment, the under-feed stoker is one answer, although to fully meet the situation its design should be such that greater flexibility of coal size and preparation may be permitted. The low-temperature carbonization of high-volatile coal is also being widely discussed, although the manufacture of such a fuel in volume does not appear to be practical at this time. It is my conclusion, therefore, that those who are interested in smoke abatement should be encouraged to legislate not against fuel but against smoke, and that it is to the interest of our industry to make available burning equipment of improved design which will accomplish the desired results.

Economics and Applied Science

COAL AND NATIONAL DEFENSE, by L. W. Householder, Vice Pres., Rochester & Pittsburgh Coal Co.

In the first World War, bituminous coal was a war essential, partly because of insufficient mine capacity, but even more so on account of transportation difficulties, and the country as a whole experienced substantial coal shortage in the early part of the war. President Wilson made a special appeal to those engaged in coal mining in August, 1918, urging both operators and miners to work hand in hand in relieving the coal shortage. In the present war and our national defense program, coal is of even greater importance, as bituminous coal furnishes approximately one-half of the nation's total energy derived from minerals and water power. This total energy includes gasoline and oil consumed in internal-combustion engines.

L. W. HOUSEHOLDER

Bituminous coal is a basic material in the manufacture of steel and coke. It is pertinent to point out that the coke industry is the most important in the manufacture of materials for the armed forces; 2,850 pounds of coal is used in the production of 1 ton of pig iron. The production of coke and pig iron directly parallel each other, and without an ample supply of high-grade coking coals our great armament program would fall. At present our by-product coke plants are using approximately 90,000,000 tons of high-grade bituminous coal. In addition to producing coke for the manufacture of steel, we are producing 1,500,000,000 lb. of ammonia sulphate, used for explosives and fertilizer; over 130,000,000 gal. of benzol, which is important to our vital chemical industries; 25,000,000 gal. of toluol, which is used for the manufacture of explosives; 400,000 gal. of phenol, used for medicines; in addition to a host of other by-products, ranging from plastics, which are taking the place of our undersupply of aluminum and magnesium, down to the ordinary aspirin and dyes.

Railroads

Bituminous coal furnishes 85 percent of all the fuel and energy consumed by our railroads, and at the present time the railroads of the country are requiring over 75,000,000 tons of bituminous coal per year. Bituminous coal furnishes 49 percent of all the fuel and energy used by electric public utilities, and approximately 75 percent of all the fuel and energy used by our general manufacturing plants. In the year 1940 they consumed approximately 250,000,000 tons. Our good neighbor on the north, the Dominion of Canada, who is now at war, will require approximately 15,000,000 tons per year of high-grade coal to supply their by-product ovens and various industrial plants which are now working at top speed producing war materials for the British Empire.

Dictators of Central Europe

Germany produced 278,000,000 tons of coal in 1935. They stepped this production up to 367,000,000 tons in 1938, which was an increase of 32 percent. By the annexation of Austria and the Saar, this was increased to 385,000,000 tons. Then came Czechoslovakia with its annual production of 31,000,000 tons of coal and its industrial plants and munition works. Coal-rich Poland produced 38,000,000 tons per year of excellent coal and, defensively weak, was the next country taken. After a short period of industrial reorganization which was necessary to insure the operation of mines and factories, Germany then moved into the Low Countries to conquer the 30,000,000 tons of annual coal production of Belgium and the 13,000,000 tons of annual production of the Netherlands. Then, through the defeat of France and the control of Italy and Rumania, Germany came into full control of 563,000,000 tons of annual production. This means that the Central Powers now have enormous tonnages of coal which can be utilized for the production of gasoline by hydrogenation, and the production of explosives and drugs, as well as many plastics that take the place of aluminum and magnesium for airplane construction. Contrast the Central Powers' production of coal with that of Great Britain, having an annual production of only 237,000,000 tons of coal annually, and no source of oil except by tidewater.

The United States has pledged itself to aid democracies with the avowed intent to defeat the Central Powers in their ruthless bid for the economic control of the world. To this end, the great coal industry of this country has pledged its support and is giving direct material support in the following manner:

1. Increased production in sufficient volume to meet any demand.

2. A better prepared product so that less coal is required to do a given piece of work, thereby placing less strain on our transportation system.

3. Producing its product and selling it at a price increase which nets only a small margin of profit.

4. Producing more tons of coal per man through mechanization, and permitting skilled and semiskilled labor to gravitate to the newer industries requiring men.

5. Training of skilled mechanics in large numbers and making these men available for the armed mechanized forces by not claiming exemptions.

INVESTIGATION OF MINE ROOF DETERIORATION, by H. B. McNary, Cons. Engr., The New River Co.

H. B. McNARY

A paper on this subject by Mr. McNary was published in the April issue of MINING CONGRESS JOURNAL and his presentation at the convention was based largely upon this published article. A number of interesting slides illustrating various types of roof conditions were shown and explained.

VOCATIONAL TRAINING AND EDUCATION FOR MINE EMPLOYES, by T. J. Thomas, Pres., Valier Coal Co.

I have felt for some years that the coal industry has failed to avail itself of the opportunity to introduce in the several mining districts a practical course in vocational training, so as to further develop a higher degree of skilled craftsmanship among at least some of its employes. I know this failure (if it can be called a failure) has been due largely to the availability of an adequate supply of labor, but this argument, in my opinion, falls short of a proper concept when, even during periods of depression, there are numerous workmen in and about our mines to whom we could and can well afford to devote some attention in making it possible for them to improve their skill. Some mining districts, notably Virginia with 540 enrollees, Pennsylvania with approximately 3,000, Kentucky with 1,200 to 1,500, and West Virginia with 2,252 attending mining classes, are addressing themselves to the

T. J. THOMAS

problem and, I am told, with highly satisfactory results.

I have just had the opportunity of examining a document that has come to my desk, dealing with the matter of labor requirements in industries essential to the defense program. We in the mining industry may find inroads made upon some of our skilled workmen, in that they will accept employment in other industries, even though it is of a temporary nature.

While coal is basic, I am not so sure that the local draft boards will exercise the degree of latitude in granting occupational deferment, change of classification, and exemption from military service that was manifested in the first World War. Indeed, while on a recent western trip I was told that of some 10,000 draftees in a certain area only 10 or 12 exemptions from military service were granted, about half being highly skilled toolmakers.

If the proper interest is shown by both management and workers in the coal industry, I feel reasonably certain that your State Department of Education, working in conjunction with the Office of Education in Washington, will provide the means to establish evening classes in the several mining districts with little or no expense to you. The whole program, if worthy of consideration, rests in your hands.

The Need and Use of Altimeter Surveys in Mine Ventilation, by Stephen Krickovic, Gen. Mine Inspector, Koppers Coal Co.

Most mine managers do not realize the magnitude of yearly investment in ventilation equipment and power, and the surprising possibilities for its inefficient use. These concealed costs are not usually scrutinized with the same critical eye that gazes on the items of daily production.

As an illustration of how tremendous ventilation expenditure can become, there is a Pittsburgh seam mine, liberating on an average of 1,500,000 cu. ft. of methane in 24 hours, with a production of 3,500 net tons per shift, in which the air shafts, fan overcasts, stoppings and doors in use represent approximately $250,000. The yearly labor cost directly chargeable to upkeep and continuation of the ventilation system is roughly $10,000. If one adds the ventilation power cost of $12,000 to $18,000 per year, it becomes difficult to select another major item in mining which requires a greater outlay of money. As a matter of interest, there are mines, large producers and very gaseous, in which the yearly ventilation power cost reaches a staggering mark of $32,000.

At the outset it is essential that all information pertaining to a ventilation system in a mine, such as the location of overcasts, stoppings, doors, all usable airways, together with the direction of air flow in them, and the producing as well as the idle areas, be correctly determined and placed on a map. Not only will this complete data facilitate intelligent planning of the survey but it will quickly reveal glaring errors of air distribution, which should be eliminated before any further studies are made. It must be remembered that changes in air volume and distribution are not permissible while the survey is in progress.

Next, from the mapped data, the general layout of the complete ventilation survey is planned. Altimeter stations are located, as a general rule, at all points in airways where the air current is split or is changed in direction; where the number of headings conducting the same current of air is increased or decreased; where the openness to air flow is appreciably reduced; and where all section splits begin and end. This rule, applicable in any mine, is really the basic outline, which can and should be expanded, on the same principle, as frequently as conditions in the survey demand.

Since the fundamental purpose of an altimeter survey is accurately to evaluate the actual coefficient of friction, or the unit resistance, in any part of the air distribution system, it becomes axiomatic that air volume stations be located if practicable at or near the pressure stations.

STEPHEN KRICKOVIC

As a final step in the "field" work for a ventilation survey, it is very desirable to obtain information in each section on the number of places and men worked, on the tonnage mined, and on the history of methane liberation in active workings and on old gobs. The information on gas should also be obtained for the whole mine. It is, of course, obvious that in all gaseous hand-loading and mechanical mines the required air volumes on splits are governed largely by the quantity of methane liberated, which in turn is primarily affected by the number of working places and the daily production on a split.

As concrete evidence of the fruit that is borne by engineering approach and planning of ventilation problems, there is a gaseous mine in the Pittsburgh seam of coal with a capacity of 3,500 net tons per shift in which the effective air volume was increased 50 percent. The cost of building overcasts and permanent stoppings, of reducing air leakage, and of converting certain headings from return to intake duty was $4,000. There was no change in the motor horsepower input.

In another mine, similar improvements undertaken to maintain the existing total air volume with more efficient distribution cost $3,500, and netted a saving of $300 in the monthly power bill.

Still in another mine, revamping of the greater part of the ventilation system, sinking of a new airshaft, installing of two high-pressure propeller-type fans increased the effective air volume 40 percent and reduced the yearly power cost $8,000.

I wish to emphasize the fact that altimeter surveys or technical analysis of mine ventilation is as significant an adjunct of safe and economical mining as any other single phase. Misuse or inefficient use of the comparatively tremendous investment for a ventilation setup in a mine is unbelievably expensive. The problem is mounting in importance with the rapid strikes made toward mechanization of mines. Concentration of methane liberation both in the fast-moving development and retreat will more than ever require a system that is perfectly balanced between safety, flexibility, and cost.

The St. Lawrence Seaway—Then What?* by B. D. Tallamy, Chief Engr., Niagara Frontier Planning Board.

Very briefly, this project, which would be closed to navigation five months each year; which would cost over a billion dollars; which would not benefit the American farmer; which by foreign competition would seriously damage American mining interests; which would inflict serious losses on industries which depend upon this country's great inland market through the dumping of foreign products carried in foreign tramp vessels operating in competition with our already subsidized American maritime industry; which would inflict such a staggering blow to American railroads, inland waterway carriers, port and terminal facilities—should the seaway be used to the extent predicted by proponents; which would jeopardize the sovereignty of the United States over Lake Michigan and undoubtedly preclude any further development of the all-American Illinois-Des Plaines-Mississippi Valley Waterway; which would have such a pernicious effect upon the general economy and welfare of labor and industry in this country, should be overwhelmingly rejected by the Congress of the United States.

The project can be defeated, in spite of the fact that the agreement authorizing this project is claimed by the administration not to be a treaty and therefore only requires a majority of both Houses of Congress for ratification. Labor and industry alike are becoming aroused. They are making their feelings known to their representatives in Congress in no uncertain terms. If the avalanche of opposition opinion continues to flow onto the desks of the members of Congress, the project shall be defeated. With your help it can be done!

B. D. TALLAMY

* This paper will be published in the June issue of Mining Congress Journal.

Beryllium

(*Continued from page* 21)

the bright future pictured for the applications of the alloys and compounds of the element. What is the hope for the future? One hope is that, as the value of finished beryllium products becomes more fully realized, the demand for these products will increase. The larger volume will doubtless result in a reduction of prices for the finished products, and this will create a greater demand for beryl. This should be reflected in a higher price for the ore, as the spread between the prices for crude beryl and for the finished products is now out of proportion. Many will be enabled to prospect for beryl, especially in connection with feldspar, quartz and mica possibilities, with more reasonable hope of remuneration. A little more attention can then be given to beryl in those quarries in which it is known to occur. While the sins of commission in beryllium statements far outweigh those of omission, yet it is certain that in some instances this mineral is overlooked. The superintendent of a large quarry was showing me over his stock pile of feldspar and I picked up a rough, dirty-looking crystal as large as my head. I asked him if that might be beryl. He smiled and explained that it took years of experience to be able to recognize the pegmatite minerals. No, that was feldspar, he said. Asked if I might have the piece, he readily assented. In my laboratory it was easily shown to be beryl. Very much needed is a method for detecting readily smaller concentrations of beryl in large massive dikes. It may be that considerable amounts of lower grade material are being overlooked.

Methods of Analysis Must be Simplified to Meet the Needs

It is a pity that the accurate determination of the percentage of beryllium oxide in a sample is a matter of so much difficulty. The country is literally flooded with false analytical reports on beryllium, and comparatively few analysts can be relied upon to report accurate analyses. In a qualitative way, an unbelievable number of false identifications label quartz and feldspar as beryl and phenacite. Spectrographic analysis, well done, is absolutely reliable in determining whether or not a given sample contains beryllium. A microscopic method of differentiating between beryl, phenacite, quartz and feldspar was recently described by the writer in a paper in a western journal. This should enable those with the most limited microscopic experience to tell the difference between these minerals, but it still leaves unsolved the important problem of readily detecting the presence of low concentrations of beryllium, which might conceivably occur in some massive dike formations. Research on this problem is in progress.

March Mercury Output Near Recent High

Domestic production of mercury amounted to 3,500 flasks in March, 21 per cent above February and 5 per cent below the recent high rate established in December, 1940, according to the Bureau of Mines.

Government Calls For Engineers

A new drive for engineers was begun by the U. S. Civil Service Commission on April 7, with the announcing of an engineer examination which includes all branches of engineering except chemical, metallurgical, marine, and naval architecture which are covered by previously announced examinations.

Applicants must have completed a four-year recognized college course except that provision is made for the complete substitution of qualifying professional engineering experience of the proper quantity, type, and quality, for the education lacking. Additional professional engineering experience, differing in kind, length, degree of progression, and responsibility, according to the grade and branch of the position applied for is also required except that graduate study in engineering may be substituted for part of the experience. The maximum age limit is 60 years.

Engineers qualified in the following specialized fields are particularly needed for the National Defense program and are urged to file their applications at once: Aeronautical, agricultural (farm machinery), construction (airports and buildings), heating and ventilating, mechanical (industrial production and diesel design), ordnance, radio, safety, sanitary (especially public health), structural (building design), and welding.

The duties of these positions will include design, construction, and research in the various branches of engineering. The positions pay from $2,600 to $5,600 a year. Applications will be rated as they are received at the Commission's Washington Office until June 30, 1942.

Further information and application forms may be obtained from the Civil Service Commission, Washington, D. C.

Priorities

(*Continued from page* 11)

duction several months in advance, and must purchase their raw materials accordingly.

"Manufacturers of mining machinery advise that they are experiencing considerable difficulty in obtaining key materials, such as certain alloy steels and non-ferrous metals and alloys, needed in the production of mining equipment and parts. Specifically, they find themselves unable to secure preferential ratings for their requirements of such key materials, and are advised that such ratings must be secured by their individual customers, who in this case are the mine operators.

"This seems to present a problem of almost impossibly complicated proportions. The Bituminous Coal Division records show over 13,000 coal mines in this country, of which there are certainly several hundred of major size and whose output is definitely needed to maintain defense and industrial production. A similar situation applies in the metal mines. To require an individual application in each case where mining machinery or repair parts of alloy steel, for example, are needed would seem far too cumbersome a procedure.

"Because of mining's basic character as a defense industry, we respectfully suggest that some general or blanket priority consideration be given to its needs, and to the needs of manufacturers for the key materials required in producing mining equipment. Such a rating or classification would greatly simplify the problem above referred to, and would facilitate an orderly supply of materials essential to the mining industry in maintaining continued and efficient production."

The priorities system is flexible and is designed to "put first things first." In meeting the urgent requirements for armament production, it should also recognize those basic mineral industries upon which such production ultimately rests. Although widespread applications of blanket priorities would obviously defeat the ends of the program, it is urgently to be hoped that some reasonable solution of mining's equipment problems may be worked out promptly, thereby avoiding acute difficulties in the supply of metals and coal as defense production grows.

WHEELS of Government

● *As Viewed by A. W. Dickinson of the American Mining Congress*

THESE bright spring days there is an increasing military trend in the Washington atmosphere; uniforms are more in evidence every day and there is war talk in the air. Army and Navy and State Department men are constantly arriving from distant stations and other officers of these services are as constantly being transferred or promoted and thereafter departing.

United States naval patrols are breasting the blue waters of the seven seas, and Navy bases, Army bases and Air Service bases are at a fever heat of activity.

Tied in to all this movement, which means increased production in all lines, is the furnishing of the vitally needed materials won from the earth by the nation's metal and mineral mining industry. There is an aroused public consciousness as to the basic character not only of the metals and industrial minerals but also, and pointedly so, as to coal. The recent suspension of min- in the bituminous coal industry has emphasized in the minds of all in Washington the dependence of our whole industrial and defense structures on coal and metallurgical coke as the heart of our steel and much other metal production. The hard-earned lessons of the last war are being rapidly revived and relearned and with this experience so early in the present emergency, we may well believe that the importance of mining will be realized by those who will guide the nation's destiny in the months to come.

Washington Highlights

MINE INSPECTION: Bill signed by President provides Federal coal mine inspection when money appropriated.

WAGE-HOUR HEARINGS: Placer miners affected if scheduled hearings result in new rulings.

COAL ACT: Consumers Council, provided for in Act extension, not yet appointed.

COAL COSTS: Hearings soon on cost of production may change minimum prices.

OPACS: Office of Price Administration and Civilian Supply created under Henderson.

TAXES: Big boosts being discussed to produce 12 2/3 billions revenues.

CRITICAL MATERIALS: New list made public by Stettinius.

PRIORITIES: Mining men and manufacturers striving to secure materials essential to supply machinery and parts.

SOCIAL SECURITY: Advocates plan wide expansion in coverage with increased benefits.

IRON ORE: Vessels of Canadian registry to transport iron ore on Great Lakes for U. S.

BERYLLIUM: $25 million proposed for R.F.C. for procurement of beryllium alloys.

Tax Procedure is Ponderous

As yet there is no tangible form of bill available for study by the nation's taxpayers in the slow evolvement of what will be the Revenue Act of 1941. Public hearings before the House Committee on Ways and Means have been going forward in a desultory fashion since April 24, but as yet the Treasury has not come forward with its recommendations for amendments of the Excess Profits Tax Act of 1940. The general objective of the Treasury is an increase of 3.5 billions in taxes, designed to cover two-thirds of the current government expenditures, including defense, for the coming year. The expenditure is now estimated at $19,000,000,000, to be offset by total tax revenues of $12 2/3 billions, including the additional revenues to be produced by the new Act.

Thus far the Treasury program calls for surtaxes which will make the lowest rate of income tax payable by an individual 16.5 percent. Corporation rates would be increased by a surtax of 5 percent on corporations earning up to $25,000 and 6 percent on higher earnings. Revision of gift and estate taxes, and heavy increases and a broadening of the field of excise taxes are in the Treasury program.

Chief of Staff Colin F. Stam of the Joint Committee on Internal Revenue Taxation, who is generally understood to reflect the views of the Congressional Taxing Committees, proposed in executive session that there be more of a shift in the increased tax burden from the "ability-to-pay" class to the excise taxes in order that the consumption of non-essentials may be curtailed during the defense emergency. Among his excise tax suggestions were 3½ percent on natural gas and varying rates on coffee, cocoa, tea and sugar; also an increase in the capital stock tax from $1.10 to $1.50.

Chairman of the Federal Reserve Board Marriner Eccles proposed heavier taxation of corporations and broadening of the tax base on individuals by lowered exemptions. He also proposed lowering the average income excess profits tax credit from 95 percent to 75 percent, and the invested capital credit from 8 percent to 6 percent, coupled with a heavy increase in excess profits tax rates. Leon Henderson of the Office of Price Administration and Civilian Supply argued that the tax law should be written to aid in preventing inflation and that high excises should be placed on defense-competitive goods, such as automobiles and other durable goods and products.

At the present time, observers believe that it will be early in July before a bill is ready for House action.

Social Security Plans

After Congress has completed work on the Revenue Bill and the active committees have had an opportunity to rest, it is understood that the Committee on Ways and Means will begin, possibly in September, consideration of a number of proposals to amend the Social Security Act. Among these will be increases in old-age pensions, particularly in some of the less prosperous states. There is a General Welfare Bill now before Congress which would set the old-age pension at $60 per month at age 60. It is understood that there has been serious talk in administration circles of a universal old-age pension of $30 per month at 60 years, and there is now a steering committee with a membership of 140 in the House, organized for the purpose of pushing this type of legislation.

Another administrative objective is to extend the coverage of old-age and survivors' insurance to include domestic, agricultural, institutional, municipal, county and state employes, as well as insurance agents and certain maritime workers. This would add 12 million individuals to the 57 million now covered.

Under the unemployment compensation provisions (3 percent payroll tax), plans are under way to raise the federal minimum standards with which the states must comply. The revised standards contemplate a maximum waiting period of one week, a benefit rate of more than 50 percent of the weekly wage, benefit payments for a period of 20 weeks, and smallest maximum benefit of $20. The staff of the Federal Board are known to be surveying with interest the accumulated unemployment compensation funds in a number of the states; Ohio now has in excess of $185,000,000. A further proposal which will probably be quickly approved is a moratorium and a credit for men called to the armed services in order that they may return to civilian life with their status unimpaired.

Opacs—What is It?

At mid-April the President created the "Office of Price Administration and Civilian Supply" under Leon Henderson, to include the former Consumers Division and the Price Stabilization Division of the National Defense Advisory Council. The function of the office is to exercise a broad control over all commodity prices and thus to provide protection for consumers.

Were the President to proclaim a full national emergency, there would be no question of price control authority under the National Defense Act of 1916 as amended, but until such time the assumption of price control authority is said to be based upon the Selective Service Act, the power of the Tariff Commission to make comparative studies of domestic and foreign commodity costs, the withholding of transportation facilities from violators of price schedules under the I.C.C. Act, and the "use" of strategic and critical material stockpiles.

Recently Administrator Henderson and Priorities Director Stettinius stated that the work of their respective units will be coordinated and that they are in agreement on all major policies.

Metal Supply Problems

On May 1, Director of Priorities E. R. Stettinius, Jr., issued General Metals Order No. 1, a temporary order expiring on July 15, 1941, unless extended, which is intended to prevent increases of manufacturers' inventories in 16 metals and classes of metal products, and to limit new supplies during the period to amounts reasonably necessary for working purposes. Under the order smelters, processors, fabricators and distributors must refrain from delivering metals to customers that will unduly increase inventories. Sworn statements are required from customers and a questionnaire is to follow to develop complete inventory information concerning the 16 metals.

A new and greatly expanded "Priorities Critical List" has been made public by Director Stettinius which includes metal products such as aluminum, brass, cadmium, ferrous alloys, iron, steel, mercury, nickel, tin, vandium and zinc. Zinc is subject to a special form of priority control. Producers are required to set aside a percentage of their production each month, thus creating a pool out of which the Priorities Division allocates to meet urgent needs. While Leon Henderson's office continues its admonition to primary copper producers to maintain the 12c price, it is reported that the Metals Reserve Company (R.F.C.) has arranged for the purchase of all Latin-American copper production. No decision has yet been announced of special price consideration for the copper mines of the old Lake Superior Region. An appeal for special consideration was made several weeks ago by mining men from this region in the course of which they stated that they are compelled to practice wasteful selective mining to keep their properties and communities alive.

A stir was occasioned recently in the House and Senate when the Vinson Bill giving legal authority for the exercise of priorities control was in process of passage. On the House floor, Representative Eugene Cox of Georgia secured the inclusion of an amendment providing for the appointment of a Director of Priorities to be confirmed by the Senate, and to exercise his power, subject to the prior approval of the Army and Navy Munitions Board and with the assistance of industry committees "which he is directed to establish and utilize." Soon thereafter, before the Senate Committee on Military Affairs appeared OPM Director Knudsen, Director of Priorities Stettinius, Assistant Secretary of War Patterson and others, who registered violent objection to the amendment. The Military Affairs Committee forthwith reported the bill in its original form and the rather tense situation which apparently threatened a serious disturbance in the existing setup, was ended.

More Wage-Hour Meddling

Following a Wage-Hour Division ruling on January 3, 1940, which permitted work up to 12 hours per day or 56 hours a week for not more than 14 workweeks in any calendar year without payment of overtime, for the placer gold mining industry of our northern states and Alaska, the operators of these properties had every good reason to believe that they could proceed to operate under this authority. A large number of producers have

(*Continued on page 69*)

With the COAL DIVISION

of the AMERICAN MINING CONGRESS

Report on CARRYING CAPACITY of D. C. TROLLEYS and FEEDER CIRCUITS

● ***Submitted to the Committee on Underground Power by A. L. Johnston***

THIS report, including wire tables, graphs, etc., has been prepared in response to requests from a number of members of the Coal Division of the American Mining Congress, who felt that it was a subject of special interest, and even though various wire tables and other information pertaining to copper conductors were already available. However, in practically all cases such information covered only conductors used for residence, commercial, and overhead service, and no specific recommendations or values were included for average mine installations.

Further investigation disclosed the fact that it was necessary to refer to numerous different catalogs or information sheets which were not always readily available, in order to compile the necessary data when planning for new or extensions of present electrical circuits.

Explanatory Notes Applying to Table No. 1

COLUMN 1

This column indicates size of the trolley wire conductor which ranges from 2-0 to 400,000 CM capacity, inclusive. *Standard grooved wire* is assumed for all sizes up to and including 350,000 CM and *Fig. 9 shape* for the 400,000 CM sizes. No reference is made to the so-called 6-0 trolley wire, which is not a recognized size. The 2-0, 4-0 and 350,000 CM trolley wires listed are, of course, available in either standard Fig. 8 or grooved shapes. The new A. S. T. M. standard Fig. 9 deep section grooved wire is the only shape trolley wire available at this time having an area of 400,000 CM—this shape wire is also available in the 350,000 CM size. The minimum conductivity for hard drawn trolley wire has been assumed as being 97.16 percent of the International Annealed Copper Standard.

NOTE: Part II of Mr. Johnston's report presents data on insulated conductors and will be published in a subsequent issue.

The area in circular mils. and safe load, as well as other values included in Table No. 1, have reference and apply only in case of new wire of full cross section, and in case of worn or undersized trolley conductors the current-carrying capacity will be in proportion to the remaining area.

Complete specifications on grooved shape hard drawn trolley wire have been approved by the American Society for Testing Materials under des-

TABLE NO. 1—SHOWING D. C. CARRYING CAPACITY AND RESISTANCE OF COPPER TROLLEY AND BARE FEEDER WIRE COMBINATIONS.

Trolley Wire 2-0, 4-0 or Cir. Mil. Size	H. D. Bare Feeder Conductor Size in Cir. Mil.	Trolley and Feeder Wire Combined — Area in Cir. Mil.	*Safe Load in Amps.	Volt Loss per 1,000 Ft. Per Ampere at 20° C.	†Weight lbs. per 1,000 Feet
2-0	none	133,200	319	.07741	418
4-0	none	211,600	424	.05035	642
4-0	211,600	423,200	848	.02522	1,284
4-0	250,000	461,600	910	.02337	1,414
4-0	300,000	511,600	975	.02109	1,568
4-0	350,000	561,600	1,025	.01921	1,705
4-0	400,000	611,600	1,093	.01765	1,877
4-0	500,000	711,600	1,203	.01516	2,186
4-0	600,000	811,600	1,303	.01329	2,495
4-0	700,000	911,600	1,398	.01183	2,803
4-0	750,000	961,600	1,445	.01127	2,958
4-0	800,000	1,011,600	1,490	.01066	3,112
4-0	900,000	1,111,600	1,576	.00979	3,421
4-0	1,000,000	1,211,600	1,655	.00890	3,730
350,000	none	350,000	601	.03040	1,063
350,000	250,000	600,000	1,087	.01797	1,835
350,000	350,000	700,000	1,202	.01541	2,126
350,000	500,000	850,000	1,380	.01204	2,607
350,000	750,000	1,100,000	1,622	.00980	3,379
350,000	1,000,000	1,350,000	1,832	.00799	4,151
350,000	1,500,000	1,850,000	2,194	.00583	5,694
350,000	2,000,000	2,350,000	2,477	.00459	7,238
400,000	none	400,000	671	.02687	1,202
400,000	400,000	800,000	1,340	.01359	2,437
400,000	500,000	900,000	1,450	.01210	2,746
400,000	750,000	1,150,000	1,692	.009449	3,518
400,000	1,000,000	1,400,000	1,902	.007805	4,290
400,000	1,500,000	1,900,000	2,264	.005761	5,833
400,000	2,000,000	2,400,000	2,547	.004566	7,377
Col. 1	Col. 2	Col. 3	Col. 4	Col. 5	Col. 6

* Safe load figures in this column are based on an ambient temperature of 15° C. (59° F.) and a temperature rise of 65° C. (149° F.) which gives a copper operating temperature of 80° C. (176° F.)—which temperature is not excessive in case of bare conductors. An ambient temperature of 15° C. (59° F.) was selected as representing an average value of the air temperatures encountered inside coal mines. In case of other ambient temperature values, safe load figures in this column should be modified. † Includes trolley and feeder.

ignation B47-39. The scope of these specifications takes into consideration material, tensile strength, and other properties, dimensions, and permissible variations from the approved standard shape, also resistivity as well as packing and shipping methods and inspection and cause for rejection.

Similar specifications for Fig. 9, deep section grooved, and Fig. 8 style copper trolley wire are also available under A. S. T. M. designation B116-40.

Column 2

The heading for this column is self-explanatory and refers to an auxiliary bare feeder conductor used in conjunction with trolley wire sizes in Column 1. The values given are for hard-drawn copper conductors with A. S. T. M. strandings, specifications B8-39, Class A, with the exception of the 211,600 CM (4-0) and the 350,000 CM sizes, which are assumed to be trolley wire shapes used as a feeder. Sufficient electrical connections should always be made between the trolley wire and the feeder to insure an equalized voltage on the two conductors. A very economical and efficient means for accomplishing this result is to utilize dual type trolley and feeder clamps for this purpose, in which case only one insulated mine hanger for both conductors is required at each suspension point.

Column 3

The area in cir. mils. as shown obviously includes the total capacity of both the trolley and the feeder wire combination, and assumes that new trolley wire of full cross section is used; in case of worn trolley wire, the reduced area resulting should be considered as affecting the safe load values as well as the resistance. (See explanatory notes for Column No. 1.)

Column 4

As noted from Table No. 1, the safe load figures in this column are based on an ambient temperature of 15° C. (59° F.) and assume a temperature rise of 65° C. (149° F.), which will permit the bare conductors to operate at a temperature of 80° C. (176° F.). In case of a higher ambient temperature the current-carrying capacity would be decreased approximately 1 percent for each degree Centigrade rise, or the conductor would have approximately 1 percent additional current-carrying capacity for each degree Centigrade decrease in ambient temperature. While it is possible to operate bare hard-drawn copper conductors at a temperature of 100° C. (212° F.) without any detrimental effect on their temper, it was felt that a conservative figure of 80° C. (176° F.) would permit higher intermittent peak loads than those shown without harmful results to the wire. The temperature values referred to in this paragraph are based on a continuous ampere load as shown in column 4, but where the service is intermittent, as is usually the case in mine work, the maximum heating values indicated will not occur.

Safe load figures are also based on conductors being installed in a horizontal position and located inside the mine where normal parallel air currents prevail and the wires do not have the benefit of a cross air current. The conductivity of the feeder cables and trolley wire is based on 97.16 percent I. A. C. S.

Attention is called to the fact that all the values given in this column have reference only to the heating effect produced on the wire by the current and in most cases the voltage drop (on account of the distance) would be the determining factor, rather than the temperature of the wire.

The safe load values shown in column 4 of Table No. 1 in the majority of cases are based on a combination of a trolley and feeder line. An additional table has been prepared which is designated as Table No. 2 (shown on page 61). The values in this table apply in case of bare stranded hard-drawn conductors and also include reference to the smaller sizes of bare solid wire.

Column 5

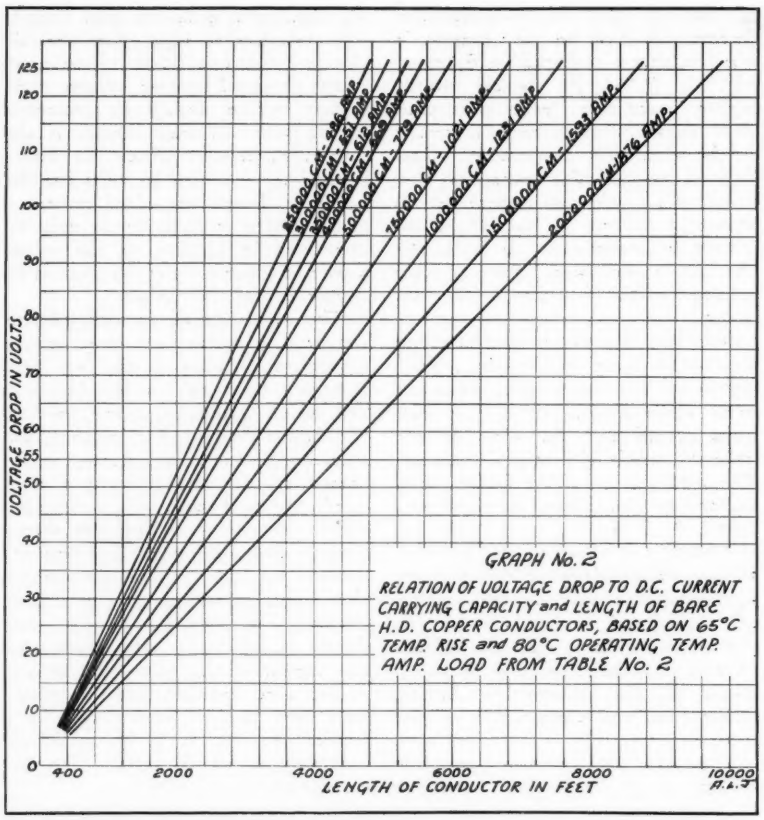
Figures shown, which represent volt loss per 1,000 ft. per ampere at temperature of 20° C. (68° F.), are, of course, equivalent to the resistance of the trolley wire or trolley and feeder combined in ohms per 1,000 ft, and it is assumed, of course, that where the track is used for the return circuit in the mines that there is sufficient cross-section in the rails and adequate bonding is used to insure that the resistance is no greater than that of the positive or copper side of the circuit. In event that the size of the rails when bonded to capacity is such that they do not provide sufficient carrying capacity to equal the wire circuit, it is necessary to supplement the rail circuit by the addition of an auxiliary grounded copper return conductor, which should be interconnected with the track circuit at the most advantageous points. In determining the total loss in volts for the complete circuit, the added resistance of the return or track circuit must be considered in addition to the values shown in column 5 for the positive or copper side of the circuit.

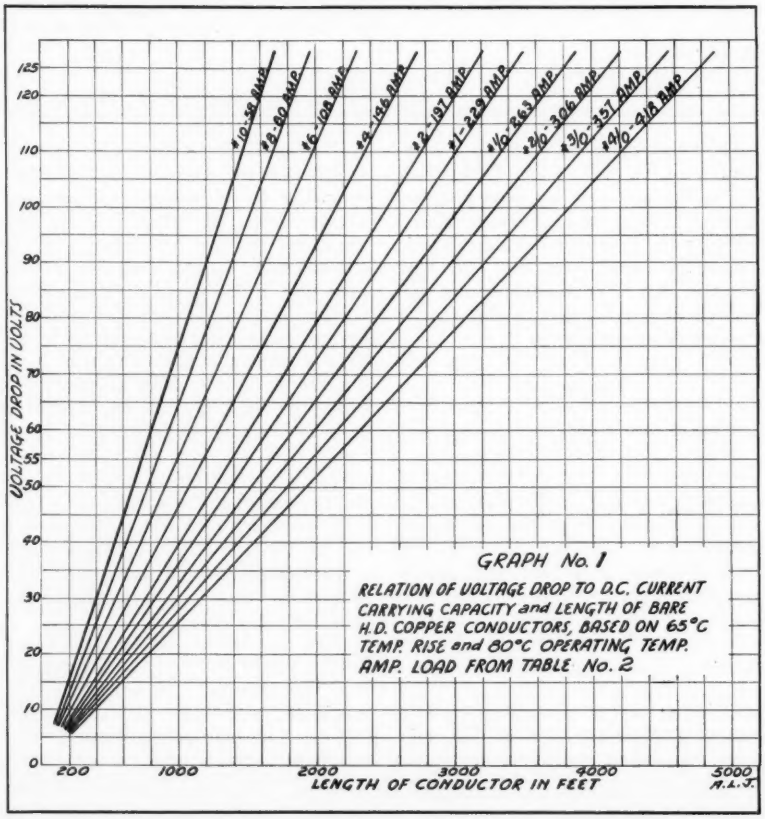
The values shown in this column for bare conductors are more or less approximate, owing to the fact that there are so many variables involved and which would, of course, modify the figures shown. For instance, the resistance of conductors varies for the same cir. mil. area between a solid conductor and that of a stranded cable. In case of trolley wire shapes there is also a difference in ohms resistance per 1,000 ft. between that of the round, grooved, Fig. 8 or Fig. 9 shapes. The resistance of the conductor is, of course, also affected by the temper of the wire—soft or annealed wire obviously has less resistance than that of hard drawn in a similar size. A. S. T. M. minimum requirements are as follows for the various tempers of wire:

	Conductivity I. A. C. S. % at 20° C.	Resistivity Lbs. per Mile Ohm at 20° C.
Hard Drawn	96.16	910.15
Medium Hard Drawn	96.66	905.44
Soft or Annealed	98.16	891.58

The ambient temperature, as well as location and position, and whether operating under intermittent or continuous load, all directly affect the resistance of any conductor. It is also necessary to call attention to the fact that in computing voltage drop for D. C. circuits, a knowledge of the current and resistance values is all that is required. However, for A.C. circuits it is not only necessary to know the resistance but the reactance as well because on the fairly large feeder sizes the drop due to reactance may be even greater than that due to the resistance of the conductor. It is felt, however, that the values shown in this No. 5 column represent the general conditions encountered for the various D. C. electrical circuits found in the average coal mine.

Volt loss values in column 5 are based on only 20° C. (68° F.) operating temperature. However, if the maximum safe load, as indicated in column 4, is used continuously it will result in a much higher temperature than 20° C. (68° F.), with conse-


VOLTAGE DROP IN VOLTS
LENGTH OF CONDUCTOR IN FEET
M.L.J.
GRAPH No. 2
RELATION OF VOLTAGE DROP TO D.C. CURRENT CARRYING CAPACITY and LENGTH OF BARE H.D. COPPER CONDUCTORS, BASED ON 65°C TEMP. RISE and 80°C OPERATING TEMP. AMP. LOAD FROM TABLE No. 2


VOLTAGE DROP IN VOLTS
LENGTH OF CONDUCTOR IN FEET
M.L.J.
GRAPH No. 1
RELATION OF VOLTAGE DROP TO D.C. CURRENT CARRYING CAPACITY and LENGTH OF BARE H.D. COPPER CONDUCTORS, BASED ON 65°C TEMP. RISE and 80°C OPERATING TEMP. AMP. LOAD FROM TABLE No. 2

quent increase in resistance or volt loss. Therefore, in order to arrive at the actual volt loss at maximum safe load (which would produce an 80° C. or 176° F. operating temperature), multiply figures shown in this column by 1.24, as the resistance of copper increases approximately 1 percent for every 2½° centigrade rise.

Voltage Drop, Length, and Current Carrying Capacity of Conductors

In order to determine the maximum distance in feet that the safe load current in amperes, shown in Table No. 1, can be carried without exceeding a given voltage drop, divide the allowable voltage drop in volts by the product of the allowable current in amps. and resistance of the wire in ohms per foot—this will give the distance in feet for the total length of wire. Divide this result by 2 to obtain the distance from source of supply to the operating equipment.

GRAPHS

Graphs No. 1 (for No. 10 to 4-0 solid wire) and No. 2 (for 250,000 to 2,000,000 CM cables) have been compiled from values shown in Wire Table No. 2 for H. D. bare copper wire and cables, with the exception that the volt loss figures used in making the calculations have been increased by using a multiplier of 1.24 in order to compensate for the increased resistance caused by the higher operating temperature occurring under maximum load. (See explanatory footnotes for Table No. 2.)

The ampere load values indicated on graphs are the maximum for each particular conductor size, based on an ambient temperature of 15 deg. C. (59 deg. F.) with a 65 deg. C. (149 deg. F.) temperature rise, thus giving an operating temperature of 80 deg. C (176 deg. F.). All graph values are based on a maximum continuous load as shown; an intermittent or lower ampere load will cause less heating and therefore lower the resistance and the voltage drop.

Maximum distance that the ampere load values as shown on graphs can be carried without exceeding a given voltage drop can readily be determined. For example, assuming a 55-volt allowable drop for 4-0 conductor carrying 418 amperes, the graph shows a total distance of approximately 2,100 ft., or length of 1,050 ft. per polarity. These graphs have been platted with the idea of showing just how far the maximum ampere load can be carried based on any predetermined voltage loss, or what volt loss will occur under maximum ampere load carried for any given distance.

Example: What distance can a current of 424 amps. (see Table 1) with 275 volts at source be carried continuously by a 4-0 grooved trolley wire without exceeding a voltage drop of 20 percent?

Solution: Assuming the allowable voltage drop is 20 percent of 275 volts (55 volts) and the resistance per foot of 4-0 grooved trolley wire at 80° C. operating temperature is .000062434 ohms (see last paragraph reference for column 5, Table 1), the 424-ampere load figure multiplied by .000062434 equals .026472016. Dividing the volt loss of 55 by .026472016 equals 2,077 ft., and dividing this result by 2 gives approximately 1,038 ft. per

polarity which would be the maximum distance that 424 amps. could be carried continuously on this size trolley wire without exceeding a voltage drop of 55.

These results are, of course, based on the assumption that the resistance of the return part of the circuit is the same as that of the outgoing side. The values given in the above solution are, of course, based on a *continuous* 424-ampere load, but in case this load figure is reduced or used only intermittently the resistance of the circuit naturally would be decreased on account of the lower operating temperature resulting, and values shown would be affected accordingly.

The Advantage of Two Smaller Conductors Over One Larger One

A fact that should be of considerable interest to the users of wire and cable is that in most cases it will be found much more economical and satisfactory to employ two or more smaller conductors which have a total area equivalent to one single larger conductor. This suggested method does not involve any additional weight of cable or increased resistance over that of a single conductor of the same area.

By referring to Table 2—Bare Conductors, this page—it will be noted that in every case where two separate conductors are used in parallel in place of a single conductor having the same area, a considerable increase in current-carrying capacity is obtained. From the following comparisons it will be observed that the larger the cables involved, the more pronounced this difference becomes, and it is occasioned by the fact that the heat generated in the interior of larger conductors has a greater distance to travel before reaching the radiating surface.

It will be noted from comparison No. 1 that it is possible to secure 193 amperes additional carrying capacity by utilizing two 250,000 CM bare cables in parallel instead of one single 500,000 CM cable. In other words, if one 500,000 CM conductor is installed to replace a 250,000 CM conductor, the percentage of increased current-carrying capacity available is only 60% instead of 100%.

No. 2 comparison shows an additional 327 ampere capacity is secured by two 500,000 CM bare cables instead of one 1,000,000 CM.

No. 3 comparison shows an additional 586 ampere capacity is secured by two 1,000,000 CM bare cables instead of one 2,000,000 CM.

(*Continued in June Issue*)

TABLE NO. 2—HARD DRAWN BARE COPPER WIRE AND CABLE

Conductor size in AWG or Cir. Mil.	* Safe load in amps.	† D.C. volt loss per 1,000 ft. per amp. at 20° C.	Weight lbs. per 1,000 ft. (bare)
10 Solid AWG	58	1.0390	31.43
8 " "	80	.6533	49.97
6 " "	108	.4108	79.46
4 " "	146	.2584	126.40
2 " "	197	.1625	200.90
1 " "	229	.1287	253.30
1–0 " "	263	.1011	319.50
2–0 " "	306	.08021	402.80
3–0 " "	357	.06361	507.90
4–0 " "	418	.05045	640.50
250,000 Stranded	486	.04400	771.90
300,000 "	551	.03667	926.30
350,000 "	612	.03143	1081.00
400,000 "	669	.02750	1235.00
450,000 "	725	.02445	1389.00
500,000 "	779	.02200	1544.00
650,000 "	926	.01692	2007.00
700,000 "	974	.01572	2161.00
750,000 "	1021	.01467	2316.00
800,000 "	1066	.01375	2470.00
1,000,000 "	1231	.01100	3088.00
1,250,000 "	1420	.008801	3859.00
1,500,000 "	1593	.007334	4631.00
1,750,000 "	1740	.006286	5403.00
2,000,000 "	1876	.005501	6175.00

* Load figures based on an ambient temperature of 15° C. (59° F.), temperature rise 65° C. (149° F.), which would give a copper operating temperature of 80° C. (176° F.). Values are based on bare conductors installed in horizontal position and located inside mines where only normal parallel air currents prevail.

To determine the maximum distance that the current in amps. indicated in above table can be carried without exceeding permissible voltage drop, refer to Example and Solution on page 60, or Graphs Nos. 1 and 2.

† As indicated, the resistance values or volt loss given in this column apply for a given length of 1,000 ft. of conductor. Values for other distances may be easily computed from this column. Attention is called to the fact, however, that the resistance of the return circuit must be taken into consideration as well as that of the ougoing circuit. Example: If a motor is set 1,000 ft. from the power source and assuming that the resistance in the return circuit is equivalent to the outgoing circuit, it would of course be necessary to double the volt loss figures shown.

Volt loss values in this column are based on only 20° C. (68° F.) operating temperature; however, if the maximum safe load, as indicated in the second column, is used continuously, it will result in a much higher temperature than 20° C. (68° F.), with consequent increase in resistance or volt loss. Therefore, in order to arrive at the actual volt loss at maximum safe load (which would produce an 80° C. or 176° F. operating temperature) multiply figures shown in this column by 1.24, as the resistance of copper increases approximately 1 percent for every 2½° centigrade rise in temperature.

COMPARISON NO. 1

	Size C.M.	Safe load amps.	Wt. lbs. per M. ft. bare
First conductor	250,000	486	772
Second conductor	250,000	486	772
Total	500,000	972	1544
One single conductor	500,000	779	1544
		193 Amp. increase.	

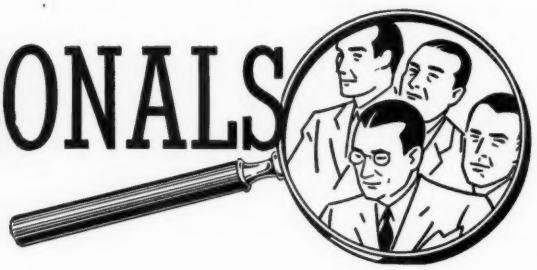
COMPARISON NO. 2

	Size C.M.	Safe load amps.	Wt. lbs. per M. ft. bare
First conductor	500,000	779	1544
Second conductor	500,000	779	1544
Total	1,000,000	1558	3088
One single conductor	1,000,000	1231	3088
		327 Amp. increase.	

COMPARISON NO. 3

	Size C.M.	Safe load amps.	Wt. lbs. per M. ft. bare
First conductor	1,000,000	1231	3088
Second conductor	1,000,000	1231	3088
Total	2,000,000	2462	6176
One single conductor	2,000,000	1876	6176
		586 Amp. increase.	

PERSONALS



N. P. Rhinehart, Chief of the West Virginia Department of Mines, recently announced that 13 additional state mine inspectors will be employed this summer, to provide a more frequent mine inspection service.

Robert A. Magee has been designated Acting Chief of the Marketing Branch of the Bituminous Coal Division, succeeding Newell W. Roberts. **William Roberts** has been made assistant compliance coordinator with the Division. **Newell W. Roberts,** who resigned, has accepted a position with Berwind-White Coal Mining Co. in New York City.

R. B. Caples, who has been general superintendent of the reduction department of the Anaconda Copper Mining Co. at Great Falls, has been named manager of the department, following the recent death of A. E. Wiggin, and **W. E. Mitchell,** who has been general superintendent of the reduction department at Anaconda, has been named manager at Great Falls to succeed Mr. Caples, and **Charles A. Lemmon** has been promoted to assistant manager of the department, from his former position of assistant general superintendent. **Floyd S. Weimer** has been made general superintendent, and **E. A. Barnard,** who was superintendent of the phosphate and acid plants at Anaconda, has been made general superintendent of the Anaconda reduction department.

Dr. James Fisher, dean of the faculty, Michigan College of Mining and Technology, is general chairman of the special committees arranging for the 1941 reunion at Houghton, on August 7 to 9.

James D. Francis, president, Island Creek Coal Co., presided at a special session on national resources at the meeting of the Chamber of Commerce of the United States, held in Washington, D. C., April 30.

John H. Collier has been elected president of the Crane Co., Chicago, to fill the vacancy created by the sudden and untimely death of Charles B. Nolte.

Howard D. McLeod, formerly shift boss at the Morris Iron mine, near Ishpeming, Mich., has been made mining captain of the Ravenna-Prickett property near Crystal Falls, Mich.

Charles H. Segerstrom, president, Nevada - Massachusetts Co., made the principal address at the annual convention of the California Dental Association in San Francisco, in April. His subject was "The Romance of Gold."

J. C. Merwin has been elected president of the Chain Belt Company of Milwaukee, succeeding the late C. R. Messinger. He was formerly vice president and treasurer. G. M. Dyke, assistant treasurer, has been made treasurer.

G. E. Gildroy has been elected president of the Bair-Collins Co. at Roundup, Mont.; he was previously superintendent of the company's coal mines.

Arnold Levy has been designated acting general counsel of the Bituminous Coal Division of the Department of the Interior. His position was formerly assistant general counsel of the Division. **Abe Fortas,** who has been general counsel, has been made acting director of the Department's new Division of Power.

Henry J. Trosson has been appointed manager of the Cleveland office of the Republic Coal & Coke Co.

Ralph M. Hoffman has been elected a vice president of the Link-Belt Co., with offices in Chicago, and having as his duties the general direction and supervision of sales for the company. **Harry L. Strube** has been appointed chief engineer of the eastern division of the company, with headquarters at Philadelphia.

Robert T. Bowman has been made director of public relations for the John A. Roebling's Sons Co.

J. D. Harlan has been named vice president and general manager of mines of the United States Smelting Refining & Mining Company, with office in Salt Lake City. He succeeds the late Edward A. Hamilton.

The new general manager of mines is widely known throughout western and Alaskan mining circles. A graduate of the Missouri School of Mines, he joined the smelting company in 1922 and was active in mining and mine examination work in Colorado and New Mexico.

Last December he was made vice president and consulting engineer of the smelting company and since then he has been engaged in exploration work in eastern states with Boston as his headquarters.

Robert Beacham, formerly superintendent for the Ayrshire-Patoka Collieries Corp. at Oakland City, Ind., has been made general superintendent of all the company mining operations and will have his offices in Indianapolis. **Lester E. Briscoe** has been promoted to the superintendency of the Patoka mine, and **George M. Dysert** has been made superintendent of the Ayrshire mine; both these mines were formerly under the superintendency of Mr. Beacham.

Col. Malcolm McAvity has been elected president of the Consolidation Coal Co., succeeding Robert C. Hill, who retains his position as chairman of the board. Colonel McAvity has a long connection with the coal mining industry. He has been sales manager and later vice president of the Consolidation Co.

Livingston Wernecke, well - known geologist of Alaska, was recently appointed consulting engineer for the Alaska Juneau Gold Mining Co., Juneau, Alaska. **J. A. Williams** has been appointed general superintendent of the operations and **E. G. Nelson,** for many years chief engineer of the company, was promoted to assistant general superintendent.

Leslie E. Harris has been made unit superintendent of the Cia. Mexicana Minera y Exploradora del Ampara, S. A., at Guanajuato, Guanajuato, Mexico. He was formerly superintendent of the mill and shops.

Roy Wallace is now superintendent of the Dayton Dredging Co.'s large dragline operation at Dayton, Nev.

George W. Land has been named a research engineer on the staff of Battelle Memorial Institute, Columbus, Ohio, and is studying methods of treatment of coal to render it dustless. He was formerly on the research staff of the Illinois Geological Survey.

Richard Mays, secretary, Pennsylvania Department of Mines, served as chairman of the mining section of the Seventeenth Annual Regional Safety Engineering Conference, held in Pittsburgh. **L. J. Bowker,** Mine Safety Appliances Co., was chairman of the conference.

E. F. Carley, advertising manager of the explosives department, du Pont Co., has retired after 30 years' service. **F. Lyman Dewey** has been named to replace Mr. Carley as advertising manager.

E. F. CARLEY

L. F. Rains was recently elected a director of the Pittsburgh Coal Co. He has been president of the A. M. Byers Co.

S. D. Ringsdorf has been reelected president for this year of the Anthracite Operators Association, at a meeting in Wilkes-Barre. **Byron W. Sleppy** was made vice president and **Bruce Payne** treasurer.

George H. Newman, chief geologist of Marsman & Co., who has had headquarters at the San Francisco offices of the company, has been transferred to the head office at Manila, P. I.

A. S. Wilson, formerly general manager of the Boone County Coal Corp., has been made vice president in charge of operations. **Howard N. Eavenson** is now consultant to the president; he was formerly vice president. **R. W. Wilmoth** has been made vice president in charge of sales.

Karl M. Marquis has been named president of W. H. Warner & Co., Inc. For the past 13 years Mr. Marquis has been a member of the sales organization of the company. **Whitney Warner, Jr.**, has been elected vice president of the company and is following the career of his father, Whitney Warner, Sr., and his grandfather, W. H. Warner, founder of the company. **Whitney Warner, Jr.**, was also elected president of the Warner Collieries Co. at a meeting of the stockholders and directors, held in Cleveland in April. Other officers elected at the same time were: **R. S. Geddes**, vice president; **K. B. Whitworth**, secretary-treasurer; and **W. C. Adams**, assistant secretary-treasurer.

J. H. Sampson has been elected a member of the board of directors of the IXL Mining Co., Masbate, P. I., to succeed **Charles A. Mitke.**

C. B. Strachan has retired from the position of general superintendent of mines for the American Zinc Co. at Mascot, Tenn. **H. A. Coy**, mine superintendent, has been promoted to succeed Mr. Strachan, and **William Black** has been made mine superintendent.

Charles E. Prior, mining engineer of Vancouver, B. C., is now general superintendent for the Fresnillo Co., Fresnillo, Zacatecas, Mexico.

P. F. Beaudin was recently elected a director of the Isle Royale Copper Co. at Houghton, Mich., filling the vacancy on the board caused by the death of F. Ward Paine.

Daniel C. Jackling, distinguished mining engineer, president of Utah Copper Co. and managing director of mining operations of the Kennecott Copper Corp., was made an honorary member of the A. I. M. E. at a meeting of the board of directors in April.

Dr. Charles H. Behre, Jr., has been named professor of geology at Columbia University and will take charge of Columbia's courses in economic geology in September. He has been William Deering professor of economic geology at Northwestern University, Evanston.

Albert E. Petermann was elected president of the Calumet & Hecla Consolidated Mining Co., following the recent retirement of **James MacNaughton** from that position. At the same time, **Endicott R. Lovell** was chosen general manager of operations.

A. F. Benson, of Virginia, Minn., has been appointed inspector of mines for St. Louis County, succeeding **E. Smith**, of Eveleth, Minn.

George F. Campbell, vice president and general manager of the Old Ben Coal Corp., has been elected president of the Illinois Coal Operators Association, Chicago, succeeding M. F. Peltier, who died recently.

David H. Devonald, general superintendent in charge of operations of the Peabody Coal Co., has been elected to membership on the executive board of the company.

Dale L. Pitt, formerly with Premier Gold Mines, has been elected president and general manager of Kensington Mines, Inc., with office at Seattle, Wash.

George T. Harley is now general superintendent of the mine of the Union Potash & Chemical Co. at Carlsbad, N. Mex., and will be in charge of the operating departments. He was formerly assistant mine superintendent.

Walter B. Lenhart, metallurgical engineer, has resigned as general superintendent of Tungstar Corp. at Bishop, Calif., and has opened a consulting office in Los Angeles.

Joseph M. Smith is in charge of operations for the Vanadium Corp. of America at Placerville, Colo. He was transferred there from the position of general superintendent of the Conger mine of the company at Boulder, Colo.

Dan K. Harper is now in charge of the Golden Turkey mine, Cleator, Ariz. He was formerly superintendent of the Williams mine of the Continental Mining Corp. at Kingman, Ariz.

— *Obituaries* —

Albert E. Wiggin, 56, manager of the reduction department of the Anaconda Copper Mining Co., Great Falls, Mont., died in a Butte hospital April 18, after a very brief illness. He had long been prominent in his professional capacity and had taken an active part in the civic life of the state.

His career started with his graduation from the Massachusetts Institute of Technology in 1907, after which he went to Montana, where he was employed by the Boston-Montana Co. in Great Falls. He later remodeled the copper concentrator at Anaconda and became superintendent of the plant. Since 1918 he had been at the Great Falls plant as general superintendent, and as manager of the reduction works, which position he held at the time of his death.

Moses F. Peltier, vice president in charge of operations of the Peabody Coal Co., and president of the Illinois Coal Operators Association, died on April 2 of a brain hemorrhage at his office in Chicago. He was 65 years old. For his entire active life he had been connected with the coal mining industry, starting as a coal miner and, after 1897, in various capacities with the Peabody Coal Co. He had also conducted several coal surveys for the Governments of the United States and Canada.

A. Fred Phelps, superintendent of the Pardee & Curtin Lumber Co., Webster Springs, W. Va., died in St. Mary's Hospital at Clarksburg, W. Va., on April 2 of coronary thrombosis.

Truman M. Dodson, II, vice president of the Weston Dodson Co. of Bethlehem, Pa., died on April 14, following an operation at a hospital in Ann Arbor, Mich. He was 63 years old. He was a native of Bethlehem and graduated from Lehigh University in 1900. The coal mining and distributing company of which he was an officer was founded by his uncles, Weston Dodson, and the late Truman M. Dodson.

Edward C. O'Keeffe, 61, head metallurgist in the Coeur d'Alene district for the American Smelting & Refining Co. and the Federal Mining & Smelting Co., died recently in a hospital at Wallace, Idaho, of a heart attack, following a short illness. He had been associated with the A. S. & R. Co. for the past 28 years; and he was at one time a professor of chemistry and metallurgy at the Kansas State School of Mines.

NEWS and VIEWS

Zinc Institute Meets

The place of zinc in the national defense program was the keynote of discussions at the 23rd annual meeting of the American Zinc Institute held in St. Louis, on April 28 and 29. Representatives from all the sections of the industry including ore production, smelting and refining, and by-product production attended.

The progress of the Institute's regular activities was the subject of reports by officers and committee chairmen at the opening session on Monday morning. At this session, the important subject of "Zinc in National Defense" was covered by John A. Church, consultant on copper and zinc, Office of Production Management, and Dr. Donald H. Wallace, of the Price Stabilization Division, Advisory Committee to the Council of National Defense, followed with an equally significant discussion of "Importance of Price Stabilization in the Defense Program."

Round-table discussions of a varied list of subjects were held on Tuesday morning. Of particular interest were the reports on "Zinc Concentrates—The Available Supply at Home and Abroad," by Elmer W. Pehrson of the U. S. Bureau of Mines, and "Slab Zinc Production" as summarized by Howard I. Young, president of the Institute. Reports on the condition of the zinc mining industry in the tri-state district and in the west were rendered by Evan Just, secretary of the Tri-State Zinc and Lead Ore Producers Association, and R. B. Caples, general superintendent of Anaconda Copper Mining Company, Great Falls, Mont.

The Institute's annual banquet and smoker was held on Monday evening. Election of officers was carried out Tuesday morning, with a luncheon meeting of the newly-elected board on Tuesday at 1 p. m. The adjournment of the Tuesday morning session marked the closing of the convention.

The visiting delegates inspected the new electrolytic zinc plant across the river from St. Louis, at Monsanto, Ill.

Nevada Scheelite Mill Enlarged

Nevada Scheelite, Inc., at Rawhide, Nev., are increasing their mill capacity from 30 to 100 tons per day. The new unit includes a crusher plant and 10 tables.

Holmes Safety Association Makes Awards

For heroic acts and meritorious services and deeds performed during 1940, medals and certificates of honor have been awarded to 10 workers in the mineral and allied industries by the Joseph A. Holmes Safety Association, D. Harrington, secretary of the Association and chief of the health and safety branch of the Bureau of Mines, recently announced.

In addition to these awards given to individuals who risked their lives to save the lives of their fellow men, said Mr. Harrington, the Association at its twenty-sixth annual meeting voted the issuance of certificates of honor to 20 other individuals for outstanding practical demonstrations, in time of emergency, of their courage, ingenuity and skill in the application of modern methods and devices in saving lives.

The Joseph A. Holmes Safety Association, named in honor of the first director of the Bureau of Mines, is composed of representatives of the leading national organizations in the field of mining, metallurgy and related industries, and has for its purpose the promotion of safety in these industries. The president of the Association is Dr. R. R. Sayers, director of the Bureau of Mines. At its meetings, held in the spring of each year, it makes awards to individuals and operating organizations for heroism, meritorious acts and for outstanding records and services performed which tend to further and encourage safety in the mineral industries.

In addition to the hero awards, the council of the Association also voted to issue certificates of honor to 207 individuals and companies that have established records for safety over long periods of time.

Certificate of Honor for Safety Awarded

J. B. Morrow (right), Pres., Pittsburgh Coal Co., receiving from J. J. Forbes (left) Supervising Engineer of the Safety Division, U. S. Bureau of Mines, the Joseph A. Holmes Safety Association certificate of honor, in recognition of the company's record in reducing accidents. Patrick J. Fagan (center), Pres., District 5, U. M. W. of A., looks on

West Virginia Offers Short Course in Coal Mining

Continuing long established practice, the School of Mines of West Virginia University will offer this summer to the miners of the state the twenty-ninth annual short course in coal mining. Similar short courses will be held at Mechanical Hall, Morgantown; Central Junior High School, Beckley; and Logan High School, Logan. Classes will begin Monday, June 16, and close Saturday, July 26. Mining extension instructors assigned to these short courses are: Logan, Page Dickens from Logan; C. O. Carman from Montgomery. At Beckley, Hobart Watson from Mount Hope; C. T. Holland from Fairmont; W. H. Steen from Welch. At Morgantown, J. S. Poundstone from Morgantown; W. B. Talbott from Bramwell.

Tri-State Mines Damaged by Flood

Mines at Oronogo and in the southeast section of the Picher area of the Tri-State mining fields were seriously damaged in mid-April, when the water from flood-swollen streams in the vicinity broke through barriers to enter the shafts. Flood waters from Center Creek poured into the Cochrane shaft in the Oronogo district, washing out the concrete shaft collar and drowned out a large acreage of underground workings. Lytle, Chat, and Par Creek in the Picher field also overflowed and flooded a dozen or more mines in the heart of that mining area. Among the mines affected were the Acme, Pawhuska, Jeff City, Grace Walker No. 2, Skelton, Admiralty, Rialto, Domado, Jay Bird, See Sah, Whitebird, and Netta. In this area the flood waters rose as much as 20 ft. in the workings from the 230- to 250-ft. level.

Attempts were immediately made to build barriers about the shaft and prevent further inflow.

High-Grade Tungsten Ore Found in Idaho

Engineers of the U. S. Bureau of Mines and geologists of the Geological Survey recently discovered a high-grade deposit of tungsten ore, vital defense material, in the Yellow Pine District, Valley County, Idaho. This district has been well-known for its antimonial gold ores, but tungsten ore had not previously been known there.

Since the maximum dimensions of the ore deposit have not yet been determined, the two agencies reported to Secretary of the Interior Harold L. Ickes, no estimate of the reserve tonnage of this strategic mineral is available now, but sufficient information already has been secured to indicate that the discovery may be one of great importance.

For the past year and a half, the Bureau of Mines and the Geological Survey have been cooperating in an investigation of ore deposits in central Idaho as a part of a program for the exploration of deposits of strategic minerals authorized by Congress on June 8, 1939. The Bureau of Mines has carried on extensive surface trenching and sampling and diamond drilling in this area. Recently, in examining the material in some of the diamond drill cores, Don E. White, the geologist of the Survey assigned to the investigations identified the tungsten mineral scheelite. As a result, the earlier samples of the deposit have been re-examined and widespread presence of scheelite proved.

Although assay returns are not complete and diamond drilling still continues, it was stated by Chief Mining Engineer Charles F. Jackson, of the Bureau of Mines, it is a fact that scheelite ore of commercial grade has been encountered by four drill holes spaced over a length of more than 300 feet with indicated widths of from 5 to 25 feet. Several 5-foot sections, he added, have assayed over 5 percent tungsten trioxide (WO_3). Ore deposits containing as little as 0.75 percent, if fairly extensive, are generally considered as being commercial grade. This deposit, if it proves to be large, will therefore be of great importance.

Exploratory work by the Department's mineral experts is still continuing in this region of central Idaho, and thus far, in addition to the discovery of the mineral scheelite, the presence of large reserves of antimony ore has been determined. The limits of the antimony ore deposit, according to Chief Engineer Jackson, have not been determined as yet, but enough already has been learned of its extent and grade to warrant the belief that it comprises an important strategic reserve of this vital mineral.

AMERICAN MINING CONGRESS

Metal Mining Convention and Exposition

San Francisco, September 29-October 2

The best time of the year to visit the Golden Gate city and to enjoy California's world-famous climate and scenic attractions.

An inspiring program is being arranged. Vital problems of the mining industry under today's critical conditions to be discussed by outstanding authorities.

An exposition and display of mining equipment and supplies — varied and complete — of interest to all.

MAKE YOUR PLANS NOW!

Mexico Orders A. S. & R. Plant Reopened

The Mexican federal labor board recently ruled that the American Smelting & Refining Company should reopen its plant at Matehuala in the state of San Luis Potosi. Last year the company claimed that ore in the district was insufficient for profitable operations and sought the labor board's permission to transfer machinery to another district. The employes then went on strike, and the company declared its collective labor contract broken and closed down.

The labor board ordered the company to reinstate 800 men, and pay wages estimated at over $200,000 for the time the plant was closed until the date of reopening. The ruling allowed the company only 48 hours to reopen the plant and 30 days for employes to return.

Sink and Float Plant for Bunker Hill & Sullivan

Bunker Hill & Sullivan Mining & Concentrating Company has concluded arrangements for the installation of an H.H. Sink and Float section in their mill at Kellogg, Idaho. The unit will have a capacity of 1,400 tons per 24 hours and is being erected under license from The Sink and Float Corporation, who control the patents. The H.H. Sink and Float process is a method for pre-concentration of ores utilizing the buoyant effect of a suspension of galena in water to produce a heavy medium in which the mineral bearing portions of the ore "sink" and the barren gangue elements "float." This process has been operated successfully in three commercial plants abroad, and the Bunker Hill unit will be the first large scale installation in the United States.

OPM Advisory Committee on Metals and Minerals Formed

The Office of Production Management has announced the formation of a committee appointed by the National Academy of Sciences and the National Research Council to advise the Office of Production Management on technical matters relating to metals and minerals. This committee is to be known as the Advisory Committee on Metals and Minerals. It is made up of the following four groups: Ferrous minerals and ferroalloys group; metals conservation and substitution group; tin smelting and reclamation group; non-metallic minerals group.

This large committee will take over the activities of the various separate technical committees that heretofore have been advising the National Defense Advisory Commission and the Office of Production Management. Clyde Williams, Director of Battelle Memorial Institute, Columbus, Ohio, is chairman of the committee; Dr. Gilbert Seil of the E. J. Lavino Company, Norristown, Pa., is chairman of the ferrous minerals and ferroalloys group; Dr. Zay Jeffries of the General Electric Company, Cleveland, Ohio, is chairman of the metals conservation and substitution group; and Mr. F. W. Willard, president of Nassau Smelting and Refining Company, New York, is chairman of the tin smelting and reclamation group. The non-metallic minerals group is in process of formation.

It is expected that this enlarged committee will make investigations for the Office of Production Management of the technological aspects of the various metals and minerals important to national defense, and will act in a technical advisory capacity to the various executives and consultants in the Metals and Minerals Section, Production Division, Office of Production Management.

RFC Loan for Copper Canyon Placers

Following a favorable report by Federal engineers on the Copper Canyon placers, 18 miles southwest of Battle Mountain, Nevada, the Reconstruction Finance Corporation has granted a loan of $1,000,000 to James O. Greenan and associates, who are planning extensive development and equipment of the property, including a dredger equipped with a 10-cu.-ft. bucket.

The deposit is said to contain 30,000,000 cu. yds. of material averaging 23 cents per cubic yard, of which approximately 7,000,000 cu. yds. are said to average 35 cents.

The Copper Canyon placers were discovered in 1910 and are credited with a production of more than $1,000,000, chiefly from shallow workings. The property was optioned by Greenan in 1936, since which time he has operated a large washing plant and has explored the numerous claims extensively.

Manganese Exploration Progresses

Robert S. Sanford, engineer in charge of the investigation now being made by the U. S. Bureau of Mines of manganese properties in the Artillery Peak section of Mojave County, Arizona, has announced that 1,000 tons of ore are in the bin ready for transportation to Boulder City, Nev., where it will be tested in the U. S. Bureau of Mines' laboratory.

A total of 2,500 tons of ore will be tested at Boulder City for the purpose of finding a method whereby the ores can be economically concentrated. The plant is equipped for making electrolytic tests.

The average grade of the deposit in the Artillery Peak section is below the requirements of the present market, but since these deposits are generally acceded to be among the largest of manganese deposits in the American continent, they will be of prime importance if a satisfactory concentration method can be worked out.

The SuperDuty Diagonal-Deck Coal Washing Table is so closely linked with new methods and new performance records in coal preparation, that many engineers credit it with creating a new horizon—if not symbolizing in itself the new horizon.

Again . . . The One and Only Coal Washing Table Exhibited at the Coal Show

Unprecedented ever increasing field acceptance is proof of that extra capacity and greater washing efficiency available in the modern design and construction of SuperDuty tables and reflected in dollar-making performance per sq. ft. of floor space occupied.

In the last twelve months the outstanding new washer projects of national and international importance requiring washing tables, have selected—almost without exception—SuperDuty Diagonal-Deck equipment.

The Deister Concentrator Company

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Coal Mines Start 1941 With Good Safety Record

As reported by the National Safety Council, and notwithstanding the fact that each of the first two months of 1941 had a major coal mine disaster (one with five fatalities in West Virginia in January and one with seven at a surface stripping operation in Illinois in February), the fatality rate for the coal mines of the United States was the lowest of which records are available for the first two months of the year. The tabulation below is significant as giving the fatality rate per million tons of coal for January and February for the past nine years as announced by the Bureau of Mines as soon as figures were available after the end of the two months every year:

Year	Fatality Rate Per Million Tons of Coal Produced
1933	2.553
1934	2.521
1935	2.628
1936	2.536
1937	2.198
1938	2.992
1939	2.064
1940	3.063
1941	1.833

The 1941 figures are tentative and the figures for every other year in the tabulation are also the tentative figures issued under essentially the same conditions as are those under which the 1941 figures have been issued. The significance of the very low fatality rate in January-February, 1941, is that the rate is materially lower than were the rates for 1933, 1936, and 1939, the three previous years that gave to the coal mines of the United States their best safety rates and records. This very low fatality rate was achieved in the face of a high rate of production, output for the 1941 January-February period being approximately 95,000,000 tons.

Rocky Mountain Institute to Meet in June

The Rocky Mountain Coal Mining Institute, through the secretary-treasurer, F. W. Whiteside, recently announced that the next convention of the Institute would be held in Denver, Colo., on June 26 to 28, inclusive. The program is not yet completed, but the traditional and welcome features of these conventions will be retained and an interesting program is promised.

PETER F. LOFTUS
Consulting Engineers
ENGINEERING AND ECONOMIC SURVEYS, ANALYSES AND REPORTS ON POWER APPLICATIONS AND POWER COST PROBLEMS OF THE COAL MINING INDUSTRY
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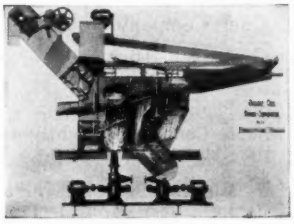
The Hydro-Separator is available in Tandem type, the Two-Cell type with pre-settling troughs, or the Single-Cell unit, depending on the problems involved.
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Cross-Entry Trolley Wires

(*Continued from page* 28)

The 350-ampere breaker is used for No. 1/0 and No. 2/0 wires and the 500-ampere breaker for No. 3/0, No. 4/0, and No. 6/0 wires, with 100 percent calibration in each case, unless higher settings are necessary in order to "carry over" momentary peaks of current during normal operation.

The wire curves in Fig. 3 and Fig. 5 apply to round copper wire of standard conductivity, but the data shown would be applicable to "Figure 8" or other shapes of copper wire of the same cross-sectional area without material difference. The curves do not apply to bronze or alloy wires, although the same principles of protection, of course, are applicable.

Conclusions and Summary

The modern air circuit breaker described protects against both trolley slack and trolley breakage (due to annealing), since the dual overcurrent feature trips the breaker after a time for overcurrents likely in time to damage the wire, and instantaneously in case of short circuits.

Large coal mines now using automatic mine sectionalizing equipment can obtain additional advantages by sectionalizing the stub and cross entries with standard breakers without automatic reclosure features. Where the cross entry is served by a feeder wire in parallel with the trolley the problem demands, for adequate protection, more detailed study and recommendations than given herein.

Cross entry trolley breakers make it necessary to shut down only one small section of the mine when trouble occurs. Furthermore, they provide far better protection because a breaker of the exact rating can be picked for protection of the known size trolley wire at each cross entry.

In addition to these advantages there are also savings realized by preventing excessive demand charges and eliminating the cost of energy wasted by short circuits of long duration.

Start New Gold Mill

Hoyle Gold Mines, Ltd., in the northeasterly limit of the Porcupine camp, Ontario, has its new mill operating at the rate of 450 tons per day.

Anaconda Conforms to Wage-Hour Ruling

In a circular issued to all their Butte district underground employes, the Anaconda Copper Mining Company re-defined, and placed in effect on April 1, a workday in conformance with recent rulings of the Wage and Hour Division of the Department of Labor.

The circular stated:

"The work day of each underground employe will start when he reports at the collar for lowering at the time specified in the posted notice at each mine, or as otherwise notified.

"An allowance of time of five minutes before the time the miner is actually required to report at the collar to be lowered will be made for the employe to check in, pick up his lamp, and bits or supplies, if any, and receive instructions from his superior, when necessary. The ruling requires that a minor allowance of time of from three to five minutes be allowed to take care of these minor duties. The checking in, getting lamps, bits and supplies, if any, may be done at the convenience of the employe, but the employe will not be credited with the total elapsed time from the first such operation to the time of checking in at the collar.

"The ruling provides: 'It would, therefore, appear proper to hold that the total time consumed in performing these operations should be considered within 'hours worked' but that the total elapsed time from the first such operation should not normally be so considered. As a practical matter a very minor allowance of time, such as three to five minutes after the official check-in and before the time that the men are required to report at the collar or portal will take care of this in all situations where it is more convenient to perform these minor operations prior to the check-in at the mine collar.' * * * 'Because of the extremely minor nature of these operations, it would appear unwarranted to state that the working day actually begins with the first such activity and includes all time thereafter.'

"At the close of the shift the hoisting will be done in time so that the employe will be allowed a similar period of five minutes to put away lamps, bits and supplies, if any, and to check out. The order in which these minor operations are performed at the end of the shift is at the convenience of the employe.

"In accordance with the ruling, the employes are not required to report at the collar all at one time. The schedules of the times for each group of employes to report at the collar of the shaft ready to be lowered are posted at the mines. The ruling provides:

"'Under the act the employer has the right to instruct certain of his employes to report later than others if the facilities for conveying the employes into the mine are inadequate to do so without a waiting period.'

"The schedules for reporting at the collar of the shaft ready for lowering have been arranged so that the waiting period of the employes will be reduced to the minimum.

"The routine of the day's work will not be changed other than the times of lowering and hoisting. There will be no change whatever in the blasting time. In general, levels lowered first will be hoisted first with the result that the total elapsed time of the shift from collar to collar, plus the allowed time for getting and returning lamps, bits and supplies, if any, and checking in and out will be eight and one-half hours in accordance with the ruling."

Coal Company Theatrical Group on Tour

H. A. Glover, vice president in charge of sales, Island Creek Coal Sales Company, recently stated that the Island Creek Players, who have given the stage play "Is This You?" in Minneapolis, Chicago, and Huntington before enthusiastic, appreciative audiences, will go on tour beginning May 6 when they play as guests of the Illinois Fuel Merchants Association in Chicago during that organization's annual convention. Arrangements have been completed for appearances in five states—Indiana, Michigan, North Carolina, Ohio, and Virginia—and in Toronto, Ont., during May and June.

Several state associations of retail coal merchants will have the players as their guests during conventions, including the Ohio Coal Conference, Columbus, Ohio, May 8; the Virginia Coal Merchants Association, Richmond, Va., June 13; and the North Carolina Retail Coal Merchants Association, Raleigh, N. C., June 17. This show, which stimulates interest in progressive merchandising for retail coal merchants, was well received by the Northwestern Lumbermen's Association, the Chicago Coal Merchants Association and the sales staff of Island Creek Coal Sales Company.

In addition to the convention appearances, Mr. Glover reports, company sponsored performances have been arranged by T. A. Day and Elmer L. Kyle, special representatives, for Island Creek retailers, their families and their employes.

First Quarter Coal Production Up

Domestic production of bituminous coal for the period January 1 to March 29, inclusive, is estimated by the National Coal Association at 131,658,000 tons (subject to revision). This represents an increase for the quarter year of 1941 over 1940 of 10.2 percent. The production last year from January 1 to March 30, inclusive, being 119,497,000 tons.

Regardless of load—of strain! Scientifically designed, Tuffy Ropes help reduce mining accidents — thus reducing expenses and delays—and they last longer. *Write for information.* T-A

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Wheels of Government

(*Continued from page 57*)

been adjusting their procedure to this ruling, and it naturally is a matter of concern to find that the whole proceeding is to be reopened at a hearing in Butte, Mont., on May 21. This has been called following representations by the International Union of Operating Engineers, which claims that the seasonal exemption should not be applied to placer gold mining by bucket dredges, draglines and other power methods.

Short notice was also recently given that the Wage-Hour Division is preparing a revision of Interpretative Bulletin No. 6, which will affect the operation of cook houses and bunk houses located at lumber and mining camps. The Wage-Hour Division states that it has found that cook houses and boarding houses are an "integral part" of the lumber and mining operations and according to the Division, no distinction can be drawn between the employe who sharpens tools for the miner or woodsman and the man who cooks his meals. Wage-Hour Division representatives have stated their belief that under this same theory, the employes of commissaries and hospitals of mining and lumber companies will be subject to the hours provisions of the law. Everyone connected with mining operation knows that mess halls, hotels and hospitals are purely service establishments provided for the convenience of the workers and that workmen are not required to take advantage of these facilities unless they so desire. It is true that many operators of mining and lumber properties in remote locations find it necessary to provide such services for their workmen, but by their very nature these service establishments should most certainly be exempt under the original provision of Interpretative Bulletin No. 6.

The iron ore producers of the Birmingham region are carrying on with their litigation to restrain the Wage-Hour Division in its collar-to-collar ruling of May 1, 1941. There is to be a preliminary hearing in the Federal District Court late in May, and it is sincerely to be hoped that this burden so arbitrarily placed upon the metal mining industry of this country will be removed.

Coal Under Government

With the National Bituminous Coal Act (Guffey Act) extended for two years from April 26, 1941, the Congress and the industry are awaiting with interest the appointment of the Consumers' Council provided for in the extending authority as a separate and independent office. Meanwhile, the House Committee on Ways and Means has appointed its subcommittee to study the provisions and administration of the Coal Act and to receive information from interested persons relative to its functioning. The subcommittee is made up of Representatives Boehne of Indiana, Chairman; Duncan of Missouri; Roberts of Virginia; West of Texas (all Democrats); Knutson of Minnesota; Jenkins of Ohio; and McLean of New Jersey (Republicans). The subcommittee is not expected to hold hearings until late in the year, after the Revenue Bill and the social security legislation have been disposed of.

In late April Secretary Ickes announced the appointment of Abe Fortas, General Counsel, Bituminous Coal Division, as Acting Director of the new Division of Power, which envisions a supervisory activity over the power resources of the country. The new General Counsel of the Bituminous Coal Division is Arnold Levy, who has previously served in the office of the General Solicitor, Department of Interior, and in the SEC.

Coincident with the wage negotiations in the bituminous coal industry, Interior Secretary Ickes has announced that he will soon call a hearing to determine changes in costs as the basis for making necessary adjustments in minimum coal prices. The statement was made that the cost of production of bituminous coal has undergone an overall reduction of 18c per ton since the 1937 figures upon which the minimum prices were based. The law provides for price readjustments whenever it is ascertained that there had been a change in excess of 2c per ton, up or down, in the weighted average cost of producing coal in the various minimum price areas. Coal division statistics show that labor charges averaged $1.20 per ton in 1940 for the district comprising Minimum Price Area No. 1, which produces approximately 70 percent of the nation's coal, and that these charges comprise 61.9 percent of the total average cost for the area in 1940.

Coal Mine Inspection

After a report by the conferees which ironed out the differences between the House and Senate versions on the qualifications of mine inspectors, the Federal Coal Mine Inspection Bill was approved by both Houses and was signed by the President on May 7. The qualification language now reads as follows: "That in the selection of persons for appointment as coal-mine inspectors no person shall be so selected unless he has the basic qualification of at least five years' practical experience in the mining of coal, and is recognized by the United States Bureau of Mines as having the training or experience of a practical mining engineer in those essentials necessary for competent coal-mine inspection; and in detailing coal-mine inspectors to the inspection and investigation of individual mines, due consideration shall be given to their previous practical experience in the work of mining coal in the state, district, or region where such inspections are to be made." It is believed that the Bureau of Mines will ask Congress for approximately $1¼ million to administer the new law in the coming fiscal year and that approximately 150 new men will be employed, who are expected to measure up to the standards which have been set through the years by the Bureau's inspection staff. While all of these men may not be mining engineers, the industry anticipates that they will be able men of the proper character and qualifications to carry on with the inspection work in an efficient and proper manner.

Pennsylvania Bars Minors From Underground Work

To coincide with a Federal regulation, the Pennsylvania State Department of Mines has issued an order barring all youths under 18 years of age from working in coal mines, the order reading as follows:

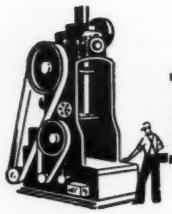
"The employment of minors under 18 years of age is prohibited in all occupations which necessitate their presence in any underground work, open pit, or surface part of any coal mining plant that contributes to the extraction, grading, cleaning or other handling of coal."

The order, it is stated, does not apply to youths engaged at a picking table, chute in tipple or in maintenance shops.

What Is a Gassy Mine?

In an information circular recently issued the Bureau of Mines, for the purpose of administration in the prevention of explosions and fires, recommends: "That any coal mine wherein methane or other combustible gas can be detected in amounts as much as 0.25 of 1 percent or more by frequent systematic searches shall be classified as a gassy mine."

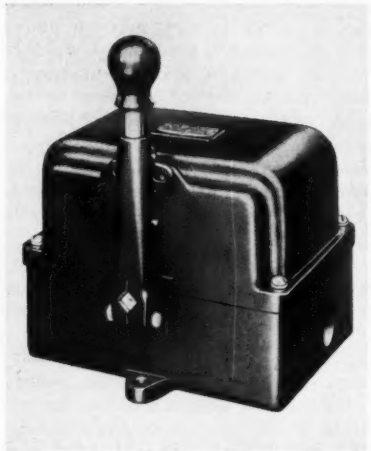
The concentration referred to is percent by volume.



MANUFACTURERS' Forum

Cam Operated Controllers

Speed up of production, through reduced fatigue, is the result claimed for the new line of Cutler-Hammer cam operated, mill duty controllers—Bulletin 14951. Extreme ease of operation with positive feel of all speed positions is obtained by using an adjustable compression type of star wheel spring.



Available in two speed, three speed, and multi-speed types, the controllers are ideal for mill auxiliaries, crane hoist, bridge, and trolley applications.

It is, however, a particularly unusual combination of features that make this new equipment of immediate interest. Following are some of the outstanding points. Contacts are vertical, double break, silver to silver. Cam shaft operates on ball bearings sealed against dust. Easily accessible terminal board simplifies installation and service. A heavy cast case and cover, for either separate or bench board mounting, provide protection from dust and mechanical injury.

Optional features include: spring return; off position latch, two, three, or five speeds.

Full information will be supplied upon request to Cutler-Hammer, Inc., Milwaukee, Wis.

Bullard Masks, Canisters Get U. S. Mine Bureau Rating

New additions to the complete line of Bullard Masks and Canisters approved by the U. S. Bureau of Mines are:

Type CM4-1, approval No. 1430, for chlorine;

Type CM-3, approval No. 1429, for ammonia;

Type CM-7, approval No. 1431, for hydrocyanic acid.

Further safety developments made since the last Bullard Catalog was issued, in 1940, may be obtained by writing E. D. Bullard Co., 275 Eighth Street, San Francisco, Calif.

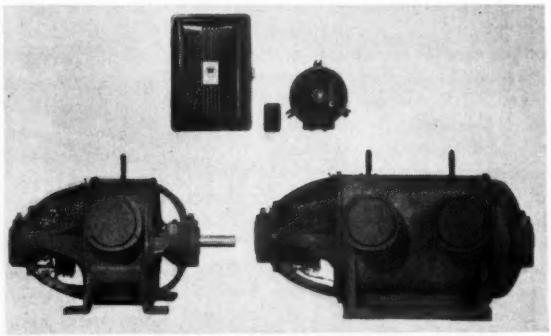
Duff-Norton Has New Mine Roof Jack

The Duff - Norton Manufacturing Company of Pittsburgh, Pa., announces a new mine roof jack. Greater capacity and rigidity, to meet the requirements of modern mining practice, are attained through stronger construction. The tube, or standard, of the new jack has thicker, heavier walls, and the jack has been enlarged and strengthened throughout to insure better service and greater safety where hazardous roof conditions exist. Quick, easy spotting under all conditions is claimed for this jack.

The improved Duff-Norton Mine Roof Jack is available with several types of handles and heads as required by mining practice.

Handles include the familiar slide type, which provides extra leverage, and is handy in close quarters; the new drop handle which is similar to the wing nut type, preferred by many because it gives a firm two-hand grip. Heads are made in four styles, including types to accommodate 4 or 6-in. H-beams, round or square timbers, as well as the ball and socket top for application against roof itself. The variety of tops and handles, together with its sturdy construction and extra capacity, makes the Duff-Norton Roof Jack adaptable to any mine roof requirement.

New Adjustable-Speed A-C Drive



Designed especially for industrial applications requiring smoothly adjustable speeds over wide ranges with constant torque, in locations where only a.c. supply is available, a new 10-to-1 adjustable-speed drive, which uses a series circuit without the usual exciter, is announced by the Westinghouse Electric & Manufacturing Co. It is available in ratings from 1 to 15 hp. with a standard speed range of from 175 to 1,750 r.p.m., for 2- or 3-phase operation on 220-, 440-, 550-volts, 60-cycle systems.

The new drive has five parts, including control; (1) a single-unit motor-generator set, consisting of a squirrel-cage induction motor driving a series d.c. generator which supplies operating voltage for (2) a d.c. series motor coupled to the driven load. In parallel with the generator series field is (3) a rheostat which controls the driving - motor speed. Control apparatus consists of (4) an across-the-line starter for the squirrel-cage motor, and (5) a pushbutton station.

The new drive is more flexible than the wound-rotor motor and is more efficient than the conventional variable-voltage system because it has no exciter rotational losses. High-torque characteristics of the d.c. series motor are combined with the flat-speed properties of the shunt motor to give good speed-torque characteristics.

Optional features include dynamic braking, and inching. Dynamic braking requires no external braking resistor, but employs a braking field wound right into the motor. Horsepower ratings are based on top speed of 1,750 r.p.m. at 40° C. continuous operation. Open frames are standard; splashproof and totally enclosed frames are available.

For further information on the series variable voltage a.c. drive, write Department 7 - N - 20, Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa.

Handy Kit For Burns

The new Foille spray kit for burns has just been announced by Mine Safety Appliances Co., Pittsburgh, Pa. The kit combines the advantages of the spray technique in the quick application of Foille for burns, with ready-to-use dressings and every needed accessory for a complete emergency burn kit, states the manufacturer.

The new Foille spray kit combines an ample supply of Foille—the new therapeutic preparation for the treatment of all types of burns; a high-pressure spray gun which screws onto the jars of Foille; suitable dressings; a sterilized bleached muslin sheet; ammonia inhalants; tubes of Foille for small burns and tubes of castor oil, for the eye. In addition, the kit contains a camel's-hair brush for applying Foille if desired, and a pair of bandage scissors. The entire outfit is contained in a waterproof and dust-proof steel case.

Dressings are furnished ready for use in Type D unit-packages which are contained in the quickly accessible upper compartment of the burn kit. Refilling and maintenance of the kit are simplified. The sturdy case is equipped with carrying handle, brackets for hanging on wall, and stop hinges so that the lid forms a work shelf when opened. For complete details on this new M. S. A. Foille spray kit, write to this publication, or direct to Mine Safety Appliances Co., Braddock, Thomas and Meade Streets, Pittsburgh, Pa. Request Bulletin No. FA-73.

Continuous Feed Drifter Built For Smoother Operation

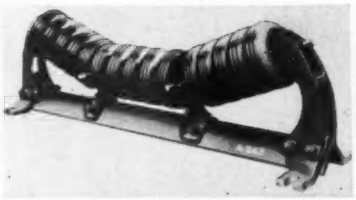
An improved, automatically fed drifting drill, recently announced by the Gardner-Denver Co. of Quincy, Ill., and known as the CF89H continuous feed drifter, has the feed motor built into the drill proper. This construction adds weight to the drill rather than to the mounting, and aids in absorbing recoil. Because of reduced vibration, the manufacturer

states, the CF89H drifter operates with smoother action, greater drilling speed, lower overall maintenance. A slowly moving piston motor—approximately 30 strokes to each 12 in. of drill travel—explains the long life and low air consumption of the drill, it is claimed.

The feed throttle controls the direction of feed as well as power and speed. Feed throttle and drill throttle are conveniently located in the drill back-head, where they are always within easy reach of the drill runner, and do not invite the destructive practice of returning drill on a full head of air. In either hard rock or in easy drilling formations, the drill is always held in proper relation to shank for highest drilling efficiency. Overall length of mounting is less than a crank-fed mounting of corresponding steel change which, the maker claims, permits maximum pitch of cut holes in drilling the round.

Pneumatic Rollers For Belt Conveyors

A recent development in the materials handling field is the pneumatic roller, for carriers on belt conveyors, wherever the shocks of impact are excessive. It is introduced by the Stephenson - Adamson Manufacturing Co., makers of the well-known line of S-A belt conveyors and bucket elevators. These pneumatic carriers are specially designed for use under loading spouts and in belt feeders where the impact of heavy bulk loads subject both conveyor belt and carrier to abnormal strains and wear. To cushion the impact of materials (and thereby prolong conveyor belt life), the rollers in these carriers are made up of a series of pneumatic rubber units, 6 in. in diameter, suggestive of miniature automobile tires. Their advantage over a solid roller has been compared to the advantage of the pneumatic tire for trucks and automobiles over the now obsolete solid rubber tire; greater resiliency to shock and impact and increased life.



The rollers in Stephens-Adamson impact carriers are mounted on the steel hub in which bearings and shaft are housed. Roller units have thick, wear-resisting treads and are inflated and permanently sealed to prevent loss of air. The assembly is built for easy servicing and quick replacement of damaged units. The carriers are identified as "Style No. 711 Pneumatic Impact Carriers."

Locke Stove New Model

The Locke Stove Company, Kansas City, Missouri, has announced the new Model 420 Warm Morning Coal Heater. These heaters are built on a new construction principle; one filling, 100 lbs. of coal, lasts a full day. They are built on a principle similar to a beehive coke oven, and furnish enough heat for the average home economically.

New Line of I-R Portable Compressors

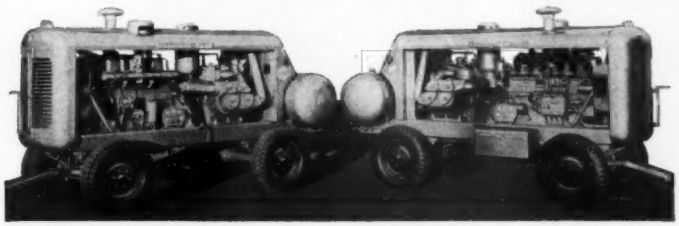
Ingersoll-Rand Co. has just announced a new line of portable air compressors which, in addition to providing features never available before in a portable, are claimed to reduce average fuel costs up to 40 percent compared to previous I-R models. These new machines are distinctive in appearance because of their copper-colored body and blue wheels, and carrying a new trade name, "Mobil-Air."

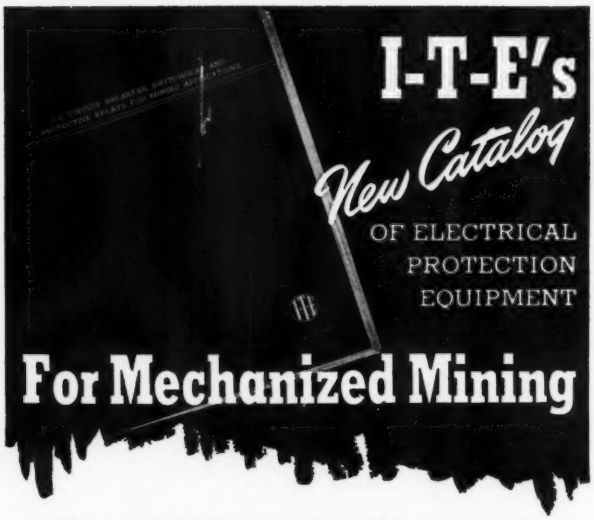
For many years the Ingersoll-Rand portable has been available with either a Waukesha gasoline engine or with the well-known Hesselman-type low-compression oil engine. Oil-engine units were of approximately the same size and weight as gasoline-engine-driven units.

In the K-series Mobil-Air units Ingersoll-Rand offers the first portable compressors ever available with engines convertible from gasoline to oil or from oil to gasoline operation by making a simple substitution of fuel accessories and without changing heads or pistons. With this feature a user can convert his unit and take full advantage of the lowest fuel cost prevailing in the particular area where he is operating.

This engine is the Waukesha Multi-Fuel engine built to Ingersoll-Rand specifications. On gasoline it operates as a new-type high-economy engine and employs the same high-turbulence combustion chamber used in the Type H oil engine. It is claimed that this results in a remarkably low fuel consumption, particularly at part loads. On fuel oil, the engine operates like the familiar easy-starting, low-compression Hesselman type.

Another Mobil-Air feature is the patented Drill-More multi-speed regulator which automatically adjusts the engine speed to the use of air and practically eliminates wasteful idling while air is being used. This device automatically selects the slowest and most efficient of three working speeds to deliver the required capacity. The machine never idles or wastes gasoline unless the low speed produces more air than is being used. The average working speed of the compressor and engine is thus much less than the rated speed on most portable jobs, thus reducing wear and tear and lengthening the life of the machine.





The new I-T-E Catalog No. 2502 is a complete description of d-c circuit breakers, switchgear and protective relays for mining applications. Its completeness recommends it particularly to those who are engaged in or contemplating mechanized mining.

Send for your copy on your company letterhead.

I-T-E CIRCUIT BREAKER CO.
PHILADELPHIA, PA.

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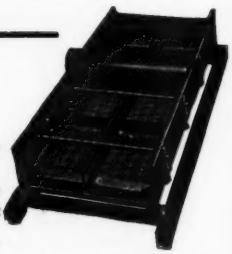

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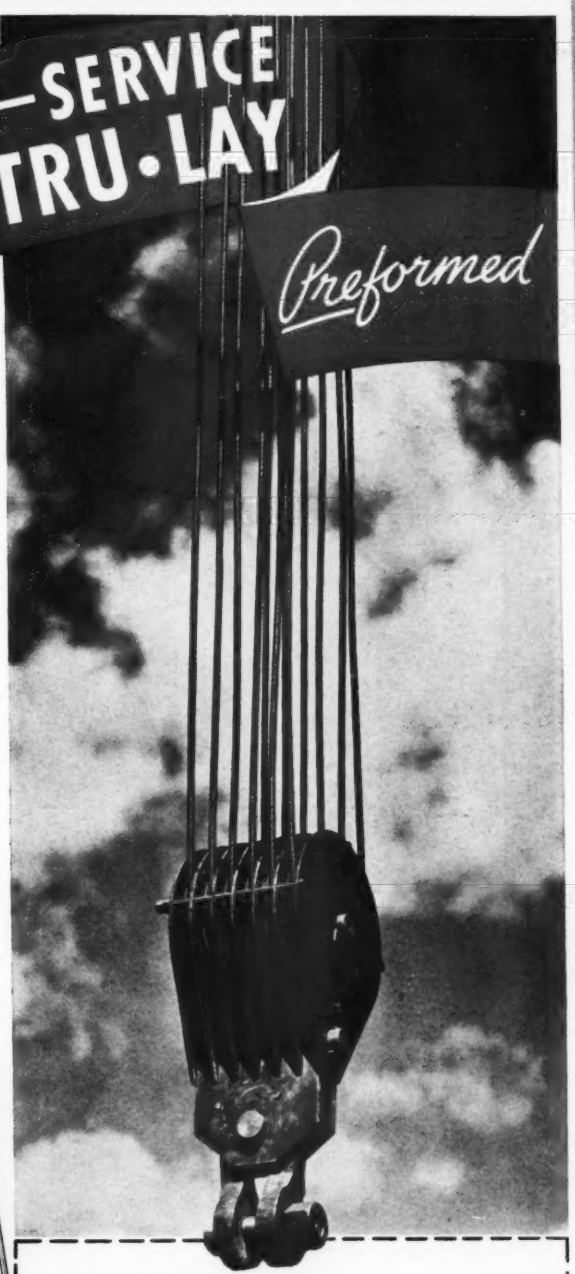

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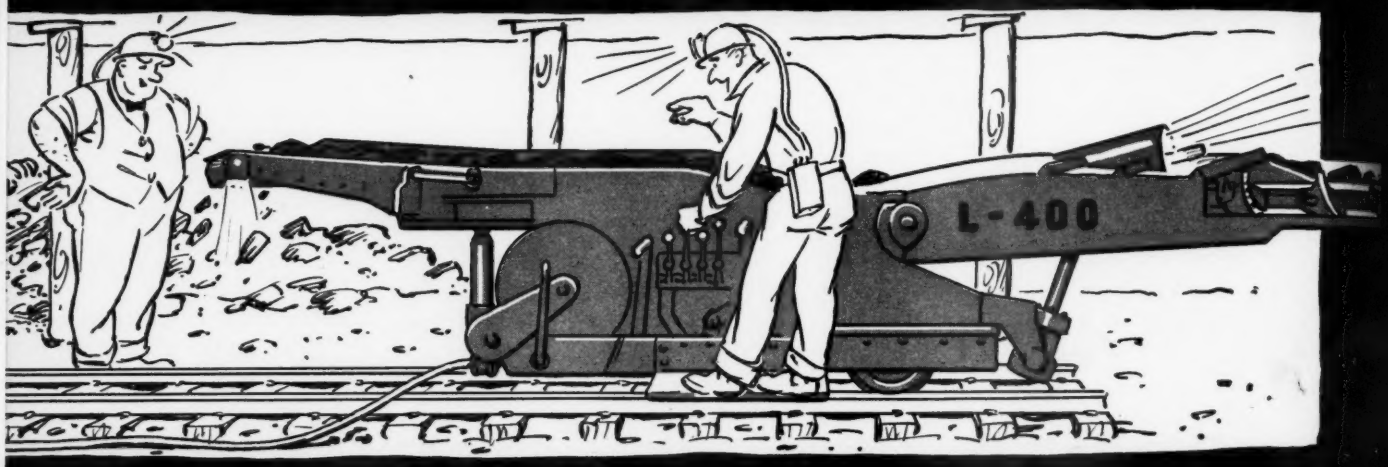


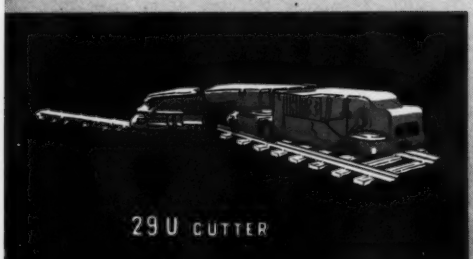
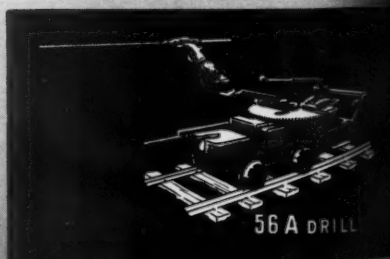
BERT the BOSS:

Tim has his props set like you said
Now let me see you raise your head.

LUKE the LOADER:

Selective mining is my job.
I load the coal and stow the gob.

SEPARATE THE WASTE FROM THE COAL AND LEAVE THE GOB IN THE MINE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